AH-64D LONGBOW HELICOPTER GUNNERY TRAINING STRATEGY

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This thesis in an assessment of attack helicopter gunnery training and the adequacy of that training as the Army fields the AH-64D Longbow attack helicopter starting in 1997. The problem confronted by this study is both institutional and unit gunnery training. This thesis is supported by an overview of the current helicopter gunnery training strategy and contains a history of the development of the attack helicopter, as well as the expectations of Aviation Branch in Force XXI. Finally, a comparison of capabilities is conducted between the AH-64A and the AH-64D.

The thesis draws several conclusions. First, the current helicopter gunnery training strategy is not acceptable for the Longbow. Second, the gunnery infrastructure is insufficient to assist commanders, analyze trends, and incorporate lessons learned. Third, the training aids and simulators available to the Longbow unit commander will likely be inadequate.

The majority of the analysis in this thesis focuses on the human dimension of attack helicopter employment. Army aviators will continue to employ helicopters in combat through the foreseeable future; therefore, training should focus on preparing them for that combat and the uncertainty that will confront them. By focusing on technology, the importance of human strengths and weaknesses may be overlooked.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

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by MAJ John D. Williams, U.S. Army

This thesis in an assessment of attack helicopter gunnery training and the adequacy of that training as the Army fields the AH-64D *Longbow* attack helicopter starting in 1997. The problem confronted by this study is both institutional and unit gunnery training. This thesis is supported by an overview of the current helicopter gunnery training strategy and contains a history of the development of the attack helicopter, as well as the expectations of Aviation Branch in Force XXI. Finally, a comparison of capabilities is conducted between the AH-64A and the AH-64D.

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LIST OF ABBREVIATIONS

AAFSS	Advanced Aerial Fire Support System
ACQ	Aircraft qualification course
ACT	*Apache* crew trainer
ADA	Air defense artillery
ADU	Air defense unit
ATGM	Antitank guided missile
ATM	Aircrew training manual
ATP	Aircrew training program
ATSC	Army Training Support Center
AWE	Advanced warfighting experiments
AWSS	Aerial Weapons Scoring System
CMS	Combat Mission Simulator
CPG	Copilot gunner
CTC	Combat Training Center
CWEPT	Cockpit weapons/emergency procedure trainer
DA	Department of the Army
DAS	Deficiency Analysis Section
DOF	Degrees of freedom
DOTDS	Directorate of Training, Doctrine, and Simulation

DTV	Day television
DVO	Direct view optics
EXFOR	Experimental Force
FAA	Federal Aviation Administration
FCR	Fire control radar
FLIR	Forward looking infrared
FM	Field manual
GASD	Gunnery and Aviation Systems Division
G-COFT	Gunnery-Conduct of Fire Trainer
GPS	Global Positioning System
GTA	Grafenwohr Training Area
HGST	Helicopter gunnery skills test
IBM	International Business Machines
IDM	Improved data modem
LCT	*Longbow* crew trainer
MACOMs	Major Army commands
METL	Mission essential task list
mm	Millimeter
MOOTW	Military operations other than war
MPRC	Multipurpose range complex
MPSM	Multipurpose submunition
MTP	Mission training plan
NASA	National Aeronautics and Space Administration
NCO	Noncommissioned officer

NLOS	Non-line-of-sight
ODCSOPS	Office of the Deputy Chief of Staff for Operations
OE^2	Ordnance Expenditure Exercise
OOTW	Operations other than war
PAM	Pamphlet
PD	Point detonating
POI	Program of instruction
RF	Radar frequency
RFI	Radar Frequency Interferometer
RL	Readiness level
ROE	Rules of engagement
SAL	Semi-active laser
SINCGARS	Single Channel Ground/Airborne Radio System
SMEs	Subject matter experts
SOP	Standing operating procedures
ST	Special text
STP	Soldier's training publications
STRAC	Standards in Training Commission
TADS	Target acquisition and designation system
TADSS	Training aids, devices, simulators, and simulations
TC	Training circular
TLE	Target location error
TOSS	Television Ordnance Scoring System
TOW	Tube-launched, optically-tracked, wire-guided missile

TRADOC	Training and Doctrine Command
TSTT	TADS selected task trainer
TTP	Tactics, techniques, and procedures
UCOFT	Unit conduct of fire trainer
USAARMC	United States Army Armor Center
USAAVNC	United States Army Aviation Center
USR	Unit status report
WAATS	Western Army Aviation Training Site
WFD	Warfighting Futures Division

CHAPTER 1

INTRODUCTION

Research Objectives and Approach

This thesis in an assessment of attack helicopter gunnery training and the adequacy of that training as the US Army fields the AH-64D *Longbow* attack helicopter starting in 1997. The problem confronted by this study is the contradictory situation in which attack helicopters receive a high priority from the Army for modernization and purchase, while the institutional and crew gunnery training that help achieve success in the full spectrum of military operations apparently does not.

This study is supported by an overview of the current helicopter gunnery training strategy published by the Army. It also contains a history of the development of the attack helicopter, as well as the expectations of Army aviation in Force XXI. This historical brief will show that the Army's attack helicopters have evolved during ongoing conflicts, rather than developed looking to future requirements. Therefore, attack helicopters have generally been designed looking backward, not forward. This is particularly critical considering the challenges of the Force XXI Aviation Branch.

The desired end state of this paper is to answer the thesis question: Is the current helicopter gunnery training strategy published and managed by the US Army Aviation Center (USAAVNC) relevant for the AH-64D *Longbow* attack helicopter? The thesis uses historical perspective, an analysis of future requirements, and future speculation to assist in developing a logical conclusion.

What is a Helicopter Gunnery Training Strategy?

Helicopter gunnery is the phrase used to describe the overarching body of skills and knowledge Army helicopter crewmembers must possess to operate the attack helicopter's weapons properly and engage targets effectively. These skills include, but are not limited to, understanding the operation and theory of weapon systems and ammunition, target acquisition, target identification, target engagement, and fire distribution appropriate for the individual aircraft, team, company, and battalion levels.[1] Helicopter gunnery encompasses those unique tasks that define the warfighting capabilities of the attack helicopter.

A helicopter gunnery training strategy is the program for training, sustaining, resourcing, and evaluating individual and collective gunnery skills in Army rotary-wing combat aviation units. This strategy includes the training of gunnery concepts and skills at the United States Army Aviation Center, Fort Rucker, Alabama, using a fusion of classroom, simulator, dry-fire, and live-fire training.[2] After this initial training, the crewmember is integrated into a unit individual and crew training program for sustainment and reinforcement of those critical gunnery skills learned at USAAVNC. The culmination of unit training is the annual, objectively scored individual and crew live-fire gunnery exercise which focuses on evaluating the crewmember's ability to engage targets in combat with accurate, timely, and properly distributed fires.

As the proponent for Army aviation training and doctrine, the USAAVNC commander is responsible for developing the gunnery training strategy for the entire Aviation Branch, as well as implementing and executing a portion of that same strategy for institutional training of new aviators. USAAVNC is also responsible for assisting tactical units with their portion of the strategy, as well as continually updating the branch training and resourcing publications; integrating modifications, such as those based on lessons-learned; and emerging technologies. Specifically, the Directorate of Training, Doctrine, and Simulation (DOTDS) at USAAVNC

operates the Deficiency Analysis Section (DAS), also known as the Aviation Hotline. The mission of DAS, as stated on the USAAVNC Internet home page, is to "Review and resolve Army Aviation Deficiencies identified by USAAVNC, the Combat Training Centers (CTCs) and Army Aviation Units."[3]

Once an aviator completes training at USAAVNC, his gaining unit commander is responsible for integrating the aviator into the unit helicopter gunnery training program, focusing on sustaining and improving skills learned in the school environment. In addition, the unit commander develops scenarios for advanced table gunnery, also known as the "commander's tables." These tables, or exercises, allow the commander to focus unit gunnery training and evaluation on his unit-specific mission essential task list (METL) tasks and mission.

In short, the gunnery training strategy is developed by USAAVNC and executed by both Training and Doctrine Command (TRADOC) and major Army commands (MACOMs). The unit commander has the latitude and resources to develop and execute METL-based gunnery scenarios to complement the USAAVNC gunnery training strategy.

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[1] *Apache* teams normally consist of two aircraft: a lead and a wingman. An *Apache* company consists of eight aircraft, normally divided into two platoons of two teams each. An *Apache* battalion consists of three *Apache* companies.

[2] Dry-fire training consists of simulated engagements from the helicopter in flight. Dry-fire is conducted without live ammunition, but requires that the crew use proper engagement TTP. Live-fire training consists of those same engagements using live ammunition.

[3] United States Army Aviation Center, "Directorate of Training, Doctrine, and Simulation homepage"; available from http://www-rucker.army.mil.dotds.htm; Internet; accessed 8 April 1997.

CHAPTER 2

LITERATURE REVIEW

The nature of this study requires research which is grouped into three major categories. These categories include historical publications (Vietnam through Gulf War articles and books), interviews, and doctrinal publications (technical and field manuals).

Historical publications mark the starting point for the literature review. These publications are accounts of actual events and are useful from the standpoint that they can reflect how the authors felt about the employment of attack helicopters, and conclusions can be drawn from the accounts concerning the training of their crews. Doctrinal publications (field manuals and technical manuals) are valued sources of information because they reflect the values and ideals of the leadership of the aviation community when they were published. Thus, these doctrinal publications can reflect how the leadership viewed gunnery and attack helicopter employment and the associated challenges for the commander in the field

There has been little critical writing completed on the subject of attack helicopter gunnery training It is interesting that a subject so rooted in the very existence of attack helicopters has such a small body of work dedicated to it Two possible reasons exist, though they may be very difficult to prove objectively First, it can be argued that critical thought about attack helicopter operations and publishing articles detailing that thought have not been a cornerstone of the aviation officer's professional development. This was evidenced in the spring of 1995 when *Aviation Digest*, the Aviation Branch's professional journal, ceased operations with little observed vocal

protest from the aviation officer corps (both warrant and commissioned). Second, Army aviation has so many diverse missions and aircraft types that gunnery issues have not been the central focus of the branch. Unlike the Armor Branch, in which every officer is a qualified to conduct gunnery in a tank, the Aviation Branch conducts combat, combat support, and combat service support missions. This diversity in the Aviation Branch has fostered an atmosphere where every initiative is tied to a specific aircraft, and therefore few initiatives receive overwhelming interest of the entire branch's officer corps (again, warrant and commissioned). Particularly as the Army moves to even more expensive, complex aircraft, aviation officers will become more compartmentalized, seeing little chance to serve in more than one type of aviation unit because of the inability to be trained in more than one type of advanced aircraft. This focus starts early in the aviator's career and may tend to create tunnel vision for the officer with respect to his particular aircraft and mission. For example, an aviation lieutenant that is trained in the *Apache* early in his career has little or no chance of serving in an assault helicopter unit equipped with UH-60 *Blackhawk* helicopters.

Because of the current state of these publications, there are very few key works in the field. The Anacapa Sciences, Inc., studies on helicopter gunnery, ammunition, and simulator effectiveness offer, by far, the most scholarly and objective study of the Army's helicopter gunnery training strategy to date. Additionally, the current Aviation Branch FMs are well researched, but like the Anacapa Sciences reports, appeal to a very small core of aviation officers.

This study will have a positive effect on the body of work on this subject. There are no historical studies of helicopter gunnery programs, focused on providing a base, or stepping-off point for the emerging, groundbreaking technology of Force XXI. If this thesis can be staffed to the Aviation Center, it could have an effect on the way the Aviation Branch designs its training for the soon-to-be-fielded AH-64D *Longbow* attack helicopter, as well as the future RAH-66 *Comanche*.

Hopefully this study will assist the Aviation Branch with the development of new or modified helicopter gunnery doctrine for the AH-64D *Longbow*. This is very critical in light of the downsizing experienced by TRADOC in 1994 to 1996; in particular, the cuts to the training development staff at the Aviation Center. In addition, the planned downsizing of the Directorate of Training, Doctrine, and Simulation (DOTDS) at the USAAVNC in fiscal year 1997 and 1998 will leave critical vacancies in the gunnery training development and STRAC functional areas. It is also hoped that this thesis will generate some level of creative thought and critical analysis within the branch's officer corps for additional study on this topic.

The Current Attack Helicopter Training Strategy

The United States Army's current attack helicopter gunnery training strategy was developed during the period 1993 to 1995. This Army-level overarching strategy for conventional aviation units is articulated in three complimentary publications produced by the Department of the Army (DA). The first of these publications is FM 1-140, *Helicopter Gunnery*. This FM is written and updated by USAAVNC. It prescribes the standards required for successful crew qualification during live-fire helicopter gunnery training. These standards include those for attack helicopter gunnery, utility helicopter door gunnery, physical range requirements, and training prerequisites. The second publication, DA Pamphlet (PAM) 350-38, *Standards in Weapons Training*, is produced by the Office of the Deputy Chief of Staff for Operations (ODCSOPS), Department of the Army, Washington, DC. This manual, also known as the STRAC (Standards in Training Commission) manual, prescribes the standards for all Army live-fire gunnery training, not just attack helicopter gunnery. It also shows the amount of ammunition allocated annually to each weapon system in the Army inventory for training and qualification. The third document is Training Circular (TC) 1-210, *The Commander's Guide to the Aircrew Training Program*. This

manual, also written and updated by the Army Aviation Center, prescribes the requirements of the Aircrew Training Program (ATP). The ATP, mandated by Army Regulation (AR) 95-3, requires that aviation commanders follow a systematic approach to training and, ultimately declaring assigned helicopter crews as combat ready, or readiness level (RL) 1. Additionally, TC 1-210 mandates that attack helicopter crews will complete helicopter gunnery qualification prior to being designated "combat ready." These documents prescribe the tasks, conditions, and standards, as well as the resources allocated for helicopter gunnery training for both Active and Reserve Component attack helicopter units. The 1995 version of TC 1-210 also implemented the first-ever direct link of helicopter gunnery to the unit status report's training or T-level assessment by the commander.

To understand the significance of these documents, it is important to put in perspective the lack of enforceable standards that existed in the helicopter gunnery training strategy prior to 1993. The 1991 version of TC 1-140, *Helicopter Gunnery*, served as the baseline for changes to helicopter gunnery implemented by USAAVNC. A review of TC 1-140 points out the weaknesses in the program: the commander did not have a systematic method for training or assessing gunnery proficiency using this manual. While there is clearly an argument for not tying the commander's hands when it comes to training, it must also be argued that the commander must at least have an understanding of the basics prior to designing his own program.

TC 1-140 is filled with examples of vague standards. For example, chapter 2 mandates that exposure time be used in the evaluation process for helicopter gunnery. Exposure time, defined as "the total time that the threat can visually acquire the firing aircraft"[1] added a scored timing aspect to the helicopter engagement. Measured from the moment when the helicopter has intervisibility with the target during the engagement to the time when the helicopter breaks that intervisibility after firing, exposure time can be very difficult to measure. Appendix I of TC 1-140

attempts to explain the process, but falls short on how the scorer should measure the time. This is a key point: the Aviation Center mandated the use of exposure time during helicopter gunnery, but failed to explain how to measure it. This failure led to a large number of permutations of not only scoring methods, but also scores between units. Techniques used by units included using a hovering aircraft next to the firing aircraft to time the exposure, videotaping of the firing aircraft from the ground, and AH-64 gun tapes from firing aircraft. These techniques led to obvious problems; because of the subjective nature of the scoring, there was an impression that there was not a level playing field for all crews. Ultimately the commander was responsible for finding a way to evaluate his crews fairly using a vague, nonspecific requirement.

While there is an argument that telling a commander what to do is not the charter of the TRADOC school, it is in the charter to define and explain standards as part of a gunnery training strategy. The importance of this gunnery strategy is central to Army attack aviation training at the training base and in tactical units. Considering the tenets in FM 25-101, *Battle Focused Training*, gunnery tasks are battle tasks for all mission essential tasks in the attack helicopter battalion and cavalry squadron, that is, individual and collective gunnery tasks are key ingredients in every mission assigned to these type units

Building from a base of success, the Aviation Branch built the bulk of its current program from that of the Armor Branch. Armor Branch has a rich heritage of gunnery excellence, and during the early 1990s, the Aviation Center wanted to emulate those successes. This meant adopting a gunnery strategy similar to that employed by units equipped with M1 tanks. FM 17-12-1, *Abrams Tank Gunnery*, specifies the tasks, conditions, and standards for M1 tank gunnery. However, the armor gunnery strategy has evolved gradually over the years and unlike the Aviation Branch strategy, has made incremental changes to the program to ensure steady improvement. Incidentally, emulating the Armor Branch was the approach taken by both the Infantry and Air

Defense Artillery branches during the incorporation of Bradley Fighting Vehicle (BFV) gunnery into their training strategies.

This incremental improvement is relatively easy to track using professional journals, field manuals, and training circulars. The September-October 1959 issue of *Armor* magazine announced a new gunnery program for the Armor branch. This program focused on not only the individual soldier as before, but also the entire tank crew. It also mandated night gunnery for the first time and required commissioned officer scorers for qualification gunnery. The article states that "the new tank gunnery qualification course is designed primarily to provide the armor commander with a means of determining tank crew proficiency as well as gunner proficiency."[2] This is precisely the same goal, as applied to attack helicopters, stated in the current Aviation Branch gunnery literature. It is also interesting to note that the Armor Branch stated this goal fully fourteen years after World War II and six years after the Korean War. Both of these wars saw revolutionary growth in the American armor force, but it took what may appear to be an inordinate amount of time for the training community to align peacetime training with wartime experiences.

Based on this timeline, as well as those changes incorporated by Armor Branch in the 1960s, 70s, and 80s, Aviation Branch should continue to refine its program, rather than implementing knee-jerk reactions. The modern attack helicopter's defining war was the Gulf War. That war was scarcely over two years when the Aviation Branch published a sweeping change to its helicopter gunnery manual and policy. In light of the resistance noted throughout the branch to these changes, the branch should take the Armor Branch's lead: incorporate gunnery lessons learned in a deliberate, systematic manner. Field commanders and operators should expect change and improvement for the gunnery program every two years in reaction to lessons learned, improvements in technology, and refinements in doctrine.

However, training literature is only part of the total "gunnery system"; that is, large amounts of resources (time, fuel, ammunition, repair parts, etc.) are required to adequately train attack helicopter crews in the employment of their crew-served weapon, the attack helicopter both individually and collectively by field unit commanders. Typically, an attack helicopter requires at least two continuous weeks on a suitable range to conduct a qualification gunnery. This training period allows completion of the required training tables mandated in FM 1-140.

Commanders are ultimately responsible for these resource challenges, and they continually voice concerns to the Aviation Center over their perception that there is a general lack of resources allocated to helicopter gunnery training and qualification. Forums, such as the annual Senior Leader's Conference at Fort Rucker, allow senior aviation commanders to gain visibility for their particular issues. Familiar themes at the conferences are the lack of ranges suitable for helicopter gunnery, and the lack of suitable objective scoring systems. These concerns are quantified when Anacapa Sciences, Inc., conducted the *Army Aviation Ammunition and Gunnery Survey* in 1987 and 1988. Anacapa Sciences administered this survey to both Active Army and Reserve Component aviation units to compile an empirical database to estimate the resources required for qualifying and sustaining adequate levels of aviator gunnery proficiency. The survey concluded the following:

> The primary conclusions are (a) a substantial number of attack helicopter units are unable to meet training standards with the resources currently available to them, (b) gunnery ranges have inadequate scoring methods or are not readily available to many units, (c) flight simulators are being used only moderately by AA (active Army) aviators for gunnery training, and (d) the current ammunition authorization approximates the minimum number of rounds needed to qualify and sustain the average aviator's gunnery skills.[3]

This study, completed nearly ten years ago, shows that while ammunition was available, resources, such as ranges, scoring systems, and time, were in limited supply for gunnery training. Particularly troublesome was the fact that when this survey was published, the Army was three

years into fielding the AH-64 *Apache* and had not yet either systematically upgraded ranges to accommodate its unique weapons or fielded a scoring system to assess crew and aircraft readiness during gunnery training and qualification. Based on this survey, a conclusion may be drawn that the underlying strategy for conducting gunnery training and qualification was flawed . In short, could the average active or reserve component attack helicopter battalion reasonably expect to complete the prescribed gunnery program? If not, what is the impact on the go to war readiness of the unit?

While the current gunnery training strategy may be flawed, attack helicopter units are seen as very relevant, effective weapons on the battlefield. This perception may have less to do with actual performance of attack battalions in dry- and live-fire training (or combat), and more to do with their battle-winning, simulated performance in simulations such as JANUS, Corps Battle Simulation (CBS), and Battalion and Brigade Simulation (BBS). Whatever the source of these impressions, warfighter exercises, as well as Combined Training Center (CTC) rotations confirm that maneuver commanders still insist that attack helicopters are combat multipliers capable of decisive action in the combined arms battle.

The Development of the Attack Helicopter

A relatively new weapon on the battlefield, the attack helicopter has developed in an evolutionary, rather than revolutionary manner over the past fifty years. The Germans were the first in to the field of armed helicopters. Before the end of 1944 the Focke Achgelis Fa-223 *Drache*, a six-seat military transport helicopter, was equipped with a single Rheinmettal 7.92 mm MG-15 machine gun flexibly mounted in the nose.[4] Despite this effort, helicopter use in World War II was limited, overshadowed by the advances in fixed-wing airplanes, particularly the strategic bomber and the jet fighter. Interest in arming helicopters would surface again in 1950

with the start of the Korean War. While experiments were conducted to develop a helicopter-borne weapons capability, the high vibration levels and general instability of the helicopter proved unsuitable for launching rockets and grenades. During this period, little thought appeared to have been given to what targets armed helicopters might engage; they were merely seen as mobile sources of firepower.[5] Despite this interest, American progress was slow.

In 1954, the French became involved in an eight-year conflict in Algeria. This conflict saw the first effective use of armed helicopters in combat. This first use was likely the result of a ground commander's quest for a flexible, rapidly responding weapons platform. According to an article in the March 1964 *Military Review*, a French G-1 light helicopter (US Bell 47/OH-13 equivalent) equipped with two stretchers landed at a French Army command post in Algeria's Atlas Mountains, anticipating use for medical evacuation. Soon after landing, a report came to the command post that a French infantry patrol was pinned down by rebel machine-gun fire and needed air support The cloud ceilings were to low for high performance aircraft, so the commander on the ground made a momentous decision; arm the helicopter. Two volunteers were strapped to the helicopter's stretchers, facing forward with their machine guns. The pilot flew over the enemy position, allowing the two riflemen to place accurate air-to-ground fires While the mission was a success, the further employment of tethered gunners was prohibited during the Algerian conflict Lessons learned from this first experience would help shape future attack helicopter design These lessons included the following desirable characteristics the capability for multidirectional fire from the helicopter, sighting independent of the position (flight profile) of the helicopter, and highly trained aviators placing fires without reliance on expensive, unreliable electronic facilities [6]

From this beginning, French armed helicopter technology advanced rapidly. Initially, helicopters were armed to escort troop-carrying helicopters. With a ratio of one armed helicopter

to five troop carriers, the French effectively provided enroute and landing zone (LZ) defensive fires, effectively countering rebel attacks on the helicopters. The development continued, with testing of various armament configurations being conducted concurrently with the updating of helicopter doctrine. The French CH-21 helicopter was at different times equipped with two 68 mm rocket pods with eighteen rockets each, .30 caliber machine guns flexibly mounted under the fuselage, and a 20 mm cannon on a shockless flexible mount in the cabin door. In the late 1950s Nord-Aviation SS-10 and SS-11 wire-guided antitank missiles were installed on the CH-34 and *Allouette II* helicopters for firing into caves located beneath overhanging cliffs and other hard targets.[7]

Thus, the French achieved a number of milestones in attack helicopter development. Notably, the first successful offensive action against an enemy force with an armed helicopter, the first use of dedicated armed helicopters to provide fires for air mobile helicopter-borne infantry forces, and the first combat use of precision-guided missiles launched from helicopters.

These developments would not go unnoticed in the United States. In 1955, the Army Aviation School at Fort Rucker, Alabama, conducted experiments with OH-13 helicopters equipped with two machine guns in fixed-forward positions. The purpose of the experiments was to provide an armament system that could suppress ground fire during air mobile assaults, similar to the capability developed by the French in Algeria. While the initial experiments were only marginally successful, experimentation continued at Fort Rucker on an ad hoc basis for the next two years. The 7292d Aerial Combat Reconnaissance (ACR) Company was formed in March 1958 to formalize the armed helicopter testing at Fort Rucker. The ACRC test fired .30- and .50-caliber machine guns, as well as rockets from 1.5 to 5 inches from a variety of helicopters. Mountings were improvised, and the "unexpected" was never far away: some 2.75 inch rockets took their tubes with them when fired.[8]

Based on the recommendations of the US Army Board on Airmobility in 1962, the US Air Cavalry was born out of the ACR company. Further experimentation with armament followed, including arming the new UH-1 *Iroquois* helicopter with machine guns and rockets. Based on the work completed at Fort Rucker, the US Army's first armed helicopter company was formed in Okinawa in July 1962, equipped with UH-1A and B helicopters. The unit deployed to Vietnam in October 1962 to provide armed escort for troop carrying helicopters. The unit tested many armament configurations, deciding in March 1963 on the seven shot 2.75 inch rocket pod, twin M-60 machine-gun combination mounted on each side of the aircraft fuselage. This system reportedly was so successful that, when employed during air mobile operations, ground fire decreased by over 25 percent.[9]

The UH-1A and B helicopters were upgraded to UH-1C versions starting in 1963. As those upgrades occurred, the Army identified the need for a truly dedicated attack helicopter. Named the Advanced Aerial Fire Support System (AAFSS), the AH-56 *Cheyenne* would be the culmination of the attack helicopter design. Because of its complexity and expected lengthy development time, the Army decided to purchase an interim attack helicopter. On 7 September 1965 the interim AAFSS, the prototype *Cobra*, flew for the first time. In April 1966 the US Army ordered 110 *Cobras*, and on 1 September 1967 the first AH-1G *Cobra* arrived in Vietnam.[10]

The AH-1G *Cobra* was arguably the world's first dedicated attack helicopter. It was built with a sleek fuselage to permit high-speed diving fire. Using steep diving flight profiles, the *Cobra* could deliver accurate 2.75 inch rocket and 7.62 mm minigun fires against a variety of targets in a role that was described as aerial fire support or aerial rocket artillery (ARA). However, due to the generally unmechanized threat in Vietnam, the *Cobra* was primarily used against personnel targets. Development of the Advanced Aerial Fire Support System (AAFSS), the AH-56 *Cheyenne*, was halted in the early 1970s as the Vietnam conflict drew to a close primarily due to rising complexity

and expense. Also during this period there was no mandated attack helicopter gunnery training conducted by field units. This may be due in part to the fact that a war was ongoing, and the conduct of that war influenced the type of training conducted. This same dynamic was seen during the Cold War when training focused on the Soviet threat in Europe with little interest in other, regional contingencies for attack helicopters.

As the Vietnam War drew to a close, experiments were conducted by the Army in which guided missiles were mounted and fired from helicopters in flight. Vietnam was the first proving ground for this new weapon, known as the tube-launched, optically-tracked, wire-guided (TOW) missile in operations against enemy armored vehicles. During May and June 1972, the Army conducted a combat trial of the TOW using two modified UH-1B helicopters. These modified missile-firing UH-1 helicopters destroyed twenty-four tanks with the TOW missile, and would usher in the era of the modern attack helicopter. This would be the next major development in attack helicopters: antitank guided missiles (ATGMs). In the mid-1970s as the Army focused on the Soviet Union's threat to Western Europe, the TOW missile was retrofitted on the AH-1G *Cobra* and fielded to tactical units. This new configuration, known as the AH-1Q, fundamentally changed the nature of attack helicopter gunnery in three important ways. First, attack helicopters would not be a primarily antipersonnel weapon anymore, and though it retained its cannon and rockets, it would be an antitank weapon. Second, tactics for firing the TOW would focus on hovering fire, not diving fire as used in Vietnam. This new firing technique also included firing rockets and cannon from hovers, not dives. The adaptation of hovering fire was due in large part to concerns about the effectiveness of Soviet air defense artillery (ADA) against helicopters flying at high altitudes, as they were employed in Vietnam. Third, unit conduct of fire and fire distribution would become a critically important employment consideration of ATGMs against a Soviet tank or motorized rifle unit.

The AH-64 *Apache*, the follow-on to the *Cobra*, was built primarily to deliver the *Hellfire* missile, a laser-guided ATGM. However, the *Apache* still had a strong link to the past in its rockets and cannon similar to the *Cobra*'s. In an interview published in the January 1979 issue of *US Army Aviation Digest*, Brigadier General Edward Browne, the program manager for the Advanced Attack Helicopter (AAH), defended the mounting of rockets on the new *Apache*. General Browne was asked, "Why do we need rockets and 30mm on the AAH?" He responded, "They provide flexibility in servicing the variety of lightly armored vehicles and personnel targets. Additionally they can be used for suppression of air defense targets. They also provide an air-to-air and self-defense capability."[11]

Employment of the *Apache* was similar to the *Cobra*: precision fires against massed enemy armor. However, the *Apache* gunnery training strategy that emerged in the early 1980s was as flawed as the *Cobra*'s gunnery strategy. The central shortcoming in the strategy would manifest itself continually at the Combat Training Centers (CTCs). This shortcoming is that attack helicopters do not fight as single entities, precision gunnery requires training, and fire distribution of precision missile fires requires careful coordination and planning.

In 1987, the Army armed the OH-58D, creating the prototype of the armed helicopter that would become the OH-58D *Kiowa Warrior*. The *Kiowa Warrior* was a small observation helicopter with impressive sighting and communications equipment. During Operation EARNEST WILL, the reflagging of the Kuwaiti oil tankers, the Army armed the OH-58D with rockets, Hellfire missiles, Stinger missiles, and a .50 caliber machine gun. While the aircraft could carry only a combination of two of the four munitions, they proved very effective in attacking Iranian gunboats in the Persian Gulf. The program progressed, and the *Kiowa Warrior* was purchased as an interim replacement for the RAH-66 *Comanche*.[12] The *Kiowa Warrior* will eventually replace all AH-1 *Cobra* aircraft in cavalry squadrons and light attack helicopter battalions. The *Kiowa*

Warrior features a forward-looking infrared sight, a laser designator, a mast-mounted sight, and sophisticated digital communications capabilities. However, it still is primarily armed with rockets and a machine gun, and the weapons are mounted on rigid pylons on each side of the helicopter's fuselage. The *Kiowa Warrior* suffers from the same shortcomings present in the first armed OH-13 helicopters: the weapons may fire fixed-forward only, and the pilot must physically point the helicopter at the target for engagement.

In the fall of 1993, a *Kiowa Warrior*-equipped company stationed at Fort Rucker deployed to Fort Hood, Texas, for unit training and gunnery. This unit, E Troop, 2d Attack Helicopter Battalion, 229th Aviation Regiment was charged with developing and validating the tactics, techniques, and procedures that would be used for the new RAH-66 *Comanche*. Part of the unit validation was an objectively scored qualification gunnery using the Area Weapons Scoring System (AWSS). This marked the first instrumented gunnery involving the *Kiowa Warrior*, and the rocket and machine-gun performance was well below that of the typical *Cobra* unit. While the *Hellfire* gunnery scores were similar to those achieved by *Apache* units, these missiles were not the primary weapon of the *Kiowa Warriors*; the primary weapons were the machine gun and rockets. The results were conclusive; the most accurate weapon on the *Kiowa Warrior* was the *Hellfire* missile, the weapon that would likely be used the least in the air cavalry role.

The next generation of the attack helicopter is the RAH-66 *Comanche*. While the *Comanche* will be technically superior to the *Kiowa Warrior*, *Cobra*, and *Apache*, it will still employ cannon and rockets like its two specialized predecessors (and even the UH-1C gunship). It will also fire precision-guided ATGMs and have a crew of two Army aviators (also like its predecessors). While its communications, flight controls, and optics will be state of the art (like the *Cobra* and *Apache* were when they were introduced), it will not represent a quantum leap in gunnery technology. The *Comanche* will still be a helicopter that fires precision and nonprecision

weapons. The *Comanche*'s capabilities may suffer from budget battles during its final development and fielding like the *Cheyenne*. As an example of the effects of budget cuts, Brigadier General James Snider, the Army's *Comanche* Program Manager stated in October 1996 that the use of low observable materials was cut from the program, foregoing the use of exotic materials and shaping. Additionally, he stated that these cuts would not degrade the *Comanche* because "the aircraft was designed around a mission, not a radar cross section requirement."[13] Specifically, technologies that engineers were counting-on for the *Comanche* have not matured as quickly as they had hoped. As the budget realities shape the *Comanche*, its more futuristic capabilities will likely be casualties.

The Comanche is designed to defeat air defense radar systems, massed armor, and other forces from the Cold War. In his article "After the Revolution," Ralph Peters states, "At present, we are preparing for the war we want to fight someday, not for the conflicts we cannot avoid."[14] Because of these facts, the *Comanche* crew will likely struggle with the same challenges their counterparts thirty years prior struggled with: what is the gunnery training strategy for this weapon system, and what is that standard?

The Attack Helicopter in Force XXI

Force XXI is the US Army of the early twenty-first century. Force XXI is the redesign of the force at all echelons whose central and essential feature will be its ability to exploit information (The US Army is defined as the active Army, Army Reserve, Army National Guard, and Department of the Army civilians.)[15] TRADOC PAM 525-5, *Force XXI Operations*, provides the blueprint for Force XXI. This blueprint has the following key principles guiding it:

> 1. The next several decades will continue to present both challenges and opportunities for the Army. On one hand, Force XXI must be prepared to conduct quick, decisive, highly sophisticated operations; while on the other, it must be ready to execute limited, often protracted operations against low-technology enemies.

2. Since 1989 [the Army] has evolved to become a learning organization. For example, ... achieving force coherence on future battlefields through shared knowledge versus physical means such as formations, matrixes, or often restrictive battlefield geometry is a bold departure from the past.

3. Force XXI Operations ... continue to require a long-term sustained commitment to excellence to develop the leaders, soldiers, equipment, and organizations capable of executing the types of operations [described in TRADOC PAM 525-5].

4. Core values, ethics, doctrinal bedrock, and moral principles will remain as the glue that binds the Army together.[16]

As our Army transitions to the Information Age of the twenty-first century, five trends will define the operational environment. These are: (1) greater lethality and dispersion, (2) increased volume and precision of fire, (3) better integrative technology leading to increased efficiency and effectiveness, (4) increasing ability of smaller units to create decisive results, and (5) greater invisibility and increased detectability. As these trends take hold, future operations will assume a much different character than those of the past.[17]

In short, developments in information technology will revolutionize how nations, organizations, and people interact. Coupled with the Army's 1993 decision to adopt a doctrine of full-dimensional operations--be they war, operations other than war (OOTW), or peace-support operations. This doctrine is a profound shift from the relatively deterministic and very appropriate scientific approach of the Cold War, with its focus on Central Europe, echelonment and presentation rates, and precise-force-ratio analysis.

For Army aviation, future information technology will greatly increase the volume, accuracy, and speed of battlefield information available. Future technologies will also require reassessment of battle command. Specifically, superior to subordinate order will be less physically imposed than knowledge imposed. This capability coupled with what may appear to be ambiguous come as you are operations may cause a major realignment of the way Aviation is employed.

If employment is impacted, so will training. In spite of the futuristic visions of TRADOC, the fact remains that the Army will employ *Longbows* until at least 2020 and the *Comanche* beyond then--armed, attack helicopters shooting precision and non-precision munitions. And based on the TRADOC *Land Warrior* (training for Force XXI) concept, aviators will continue to be trained by TRADOC, most likely at Fort Rucker, Alabama.

USAAVNC PAM 525-5, *Aviation in Force XXI Operations*, is a companion pamphlet to TRADOC PAM 525-5. The theme of the USAAVNC pamphlet is "the versatility of Army Aviation" in Information Age, Force XXI operations. While similarly forward looking as the TRADOC pamphlet, USAAVNC Pam 525-5 specifically addresses attack helicopters in future operations. Of the six Force XXI patterns of operations, attack helicopters are specifically mentioned in five: Project the Force, Protect the Force, Gain Information Dominance, Shape the Battlespace, and Conduct Decisive Operations. The other operation is Sustain the Force and is primarily a combat service support function. Recent deployments to Somalia and the Balkans have shown how aviation is involved in the shift to full-spectrum operations. However, there is little doctrinal basis for these operations, and the current generation of manuals is based on the former Soviet models of linear, echeloned enemy formations.

Based on the Force XXI requirements, the attack helicopter unit of the near future will have a large number of tasks to perform for mission accomplishment without a significantly new doctrinal base to draw from. Based on these requirements, is the current training program for attack helicopter gunnery relevant for the full spectrum of operations? Will the average attack helicopter crew be able to meet the tough requirements for Force XXI operations?

Definition of Key Terms and Acronyms

There are several key terms and acronyms which apply to this thesis and helicopter gunnery in general. They are defined as follows:

Accuracy. The standard deviation about the mean point of impact of a representative sample of rounds. As the standard deviation increases, the accuracy worsens.

Aerial Ballistics. Characteristics of aerial-fired munitions. It includes the characteristics of both fin-stabilized and spin-stabilized projectiles.

Anti-Tank Guided Missile (ATGM). The family of missiles employed from attack helicopters used primarily as direct fire, antiarmor weapons. While these missiles are capable of servicing a wide variety of targets, their shaped-charge warheads are optimized for defeating thick armor plate by penetrating the armor with small, focused penetrations.

Area Target. This term is used to describe a target that is spread out over an area, as opposed to a single point target, the opposite of area target. However, the size of the area cannot be quantified nor can a specific target be positively identified as an area target. For example, is a motor pool full of trucks an area target? Is the same motor pool full of tanks an area target? This example shows that the term area target may not be relevant for attack guidance or gunnery training.

Attack Helicopter. This is a broad term that refers to a helicopter employed as a maneuver weapons platform firing a combination of rockets, machine guns, cannon, and guided missiles.

Attack Helicopter Units. This refers to tactical units, such as battalions, squadrons, companies, and troops that are equipped with attack helicopters--AH-1, AH-64, and OH-58D(I).

Dispersion. This term refers to the degree of scatter of munitions in an impact area. Dispersion is measured by range(longitudinal) and deflection (latitudinal), relative to the firing helicopter. With most munitions, as range increases, dispersion increases.

Diving Fire. Diving fire is a direct fire engagement from a helicopter that is in a diving flight profile as specified by the aircraft's aircrew training manual (ATM). During diving fire the angles of dive and airspeed in the dive will vary between aircraft types.

Exterior Ballistics. Exterior ballistics deal with characteristics that influence the motion of the projectile as it moves along its trajectory.

Folding Fin Aerial Rocket (FFAR). An unguided rocket fired from pods mounted on attack helicopters. The MK66 FFAR, the Army's standard rocket, is produced in two varieties, as distinguished by their warheads: the point detonating (PD) warhead and the multipurpose submunition (MPSM) warhead. The PD warhead has a bursting radius of 10 meters, and a "shrapnel zone" of 50 meters upon impact. The MPSM warhead contains 9 submunitions, each capable of producing approximately 70% of the blast effect of a single PD warhead.

Gunnery Table. A gunnery exercise performed by an attack helicopter crew or unit that has a distinct task, condition, and standard. The term "table" refers to an actual graphical table in FM 1-140, *Helicopter Gunnery*, that specifies the range, ammunition load, specific weapon, and the task, conditions, and standard for each engagement.

Hellfire Missile. A laser guided ATGM featuring a shaped-charge warhead optimized for anti-armor operations. The Hellfire is the primary ATGM launched from the Army AH-64A, AH-64D, and OH-58D(I), as well as the USMC *SuperCobra*.

Hover Fire. Hover fire is defined as any engagement conducted below effective translational lift (ETL). For most attack helicopters, ETL occurs at approximately 20-30 knots

forward airspeed. According to FM 1-140, *Helicopter Gunnery*, hover fire specified for gunnery ranges requires a stationary hover, or a hover not involving any forward movement

Interior Ballistics. Interior ballistics deal with the characteristics that affect projectile motion inside the barrel or rocket tube.

Maximum Effective Range. The range at which a direct fire weapon or weapons system has a 50 percent probability of hitting (Ph) a target. (Note: helicopter cannons are tested for accuracy using a 3x3 meter target.)

Milliradian. Abbreviated as mil. A unit a angular measurement equal to 1/6400 of a complete circle. Linear distance between two points can be approximated by using the following formula: **d=r(m)/1000**, where "d" is the distance between two points (i.e., two impact locations, "r" is the range from weapon or observer to the impact points, and "m" is the distance between the two points measured in mils optically from the observation/firing point.

Multipurpose Submunitions (MPSM). A 2.75" warhead containing nine bomblets designed to deploy from the rocket warhead casing during flight at a range set electronically by the pilot firing the rocket. Once deployed, the submunitions descend near-vertically to the ground and explode. The bomblets have shaped-charges, capable of defeating armored and personnel targets.

Point Target. This term is used to describe a target that is compact, as opposed to a spread out area target, the opposite of point target. However, the size of the point target cannot be quantified. This term is normally used to describe a vehicle, such as a tank.

Point target weapon/area target weapon. Generalized terms that attempt to categorize weapon system by their accuracy and the nature of the target. Considering these categorizations, the point target weapon can place accurate fire in relation to the aimpoint; the area target weapon cannot, and generally possesses a larger degree of dispersion than point target weapons.

Qualification. This word can have two distinct meanings when used in reference to attack helicopters. The first meaning refers to the individual aviator's "qualification" to fly an aircraft. This qualification is received when the aviator successfully completes the aircraft qualification course (AQC). The second meaning refers to the individual aviator completing live-fire gunnery "qualification" in his tactical unit. Gunnery qualification is required annually for each operational attack aviator.

Range. This word can have two distinct meanings when used in reference to gunnery. When used as "*range to target*", it refers to the physical distance between the observing helicopter and the selected target. When used as "*gunnery range*", it refers to the tract of land used to fire live ordnance from the helicopter toward selected training targets.

Scout Helicopter. Any helicopter, regardless of weapons configuration, given the principal role of target location and identification, as well as security for accompanying attack helicopters

Terminal Ballistics. Terminal ballistics describes the characteristics and effects of the projectiles as they impact at the target

Tube-Launched, Optically-Tracked, Wire-Guided (TOW) Missile. A precision-guided, direct fire heavy antitank/assault weapon, suitable for engaging a variety of vehicle targets, as well as bunkers and similar fortifications Can be ground-launched (Bradley IFV, HUMMVs) or air-launched (AH-1 *Cobra*)

Transition. A course of instruction in which Army aviators learn to fly and employ advanced aircraft, also known as the aircraft qualification course (AQC). For example, in the AH-64 transition, aviators learn to fly the *Apache* in both day and night environments, performing a number of required maneuvers. In addition, aviators learn to use the aircraft's navigation, communication, and weapon systems during the instruction.

Unitary Warhead. Any 2.75" rocket warhead which does not deploy submunitions in flight. Most common unitary warhead is the M151 High-Explosive warhead, also known as the "10 pounder."

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[1] US Army, TC 1-140, *Helicopter Gunnery* (Washington: Department of the Army, September 1991), 2-11.

[2] Thomas G. Foster and John M. Pickarts, "The Tank Gunnery Qualification Course." *Armor* 5 (September-October 1959): 28.

[3] Anacapa Sciences Inc., *Army Aviation Ammunition and Gunnery Survey*, vol. 1 (Fort Rucker, AL: Anacapa Sciences, August 1988), Executive Summary.

[4] E.J. Everett-Heath, "The Development of Helicopter Air-to-Ground Weapons," *International Defense Review* 3 (March 1983): 321.

[5] Ibid.

[6] J. Pouget, "The Armed Helicopter," *Military Review* 3 (March 1964): 81.

[7] Everett-Heath, 322.

[8] Ibid.

[9] Ibid., 324.

[10] Ibid.

[11] Richard K. Tierney, "BG Edward M. Browne on the Advanced Attack Helicopter," *US Army Aviation Digest* 1 (January 1979): 4.

[12] This purchasing agreement is very similar to the decision that led to purchasing the *Cobra* as an interim replacement for the *Cheyenne*.

[13] "Cost of a Lighter Comanche is Questioned," *Jane's Defence Weekly*, 23 October 1996: 11.

[14] Ralph Peters, "After the Revolution," *Parameters* 25, no. 2 (Summer 1995): 9.

[15] US Army, TRADOC PAM 525-5, *Force XXI Operations* (Fort Monroe, VA: US Army Training and Doctrine Command, August 1994), Foreword.

[16] Ibid., 4-2.

[17] GEN Gordon R. Sullivan and LTC Anthony M. Coroalles, "The Army in The Information Age," (Carlisle Barracks, PA: US Army War College, 31 March 1995), 1.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this chapter is to outline the methods used to determine if Army aviation's current gunnery training strategy is relevant for the AH-64D *Longbow*.

This study will use the comparative analysis method. This analysis will compare the current gunnery capabilities and resource realities of the current AH-64A *Apache* attack helicopter battalion to the requirements imposed by the widely varied missions envisioned for the AH-64D *Longbow* attack helicopter battalion in the early 21st century.

This study's objective is to answer the following primary research question, Is the current helicopter gunnery training strategy published and managed by the Army Aviation Center relevant for the AH-64D *Longbow*? And the following secondary questions:

1. Does the present USAAVNC helicopter gunnery training strategy support current Army doctrine and training requirements?

2. Is TRADOC properly preparing for *Longbow* employment and training for the near term (5-10 years)?

3. If required, how should Army aviation modify its current gunnery training strategy for the *Longbow*?

Assumptions

There are several assumptions upon which the research of this thesis is based. They include:

1. The Department of the Army will continue to resource live ammunition for peace-time helicopter gunnery training and qualification.

2. Army aviation units will continue to receive enough flying hour allocations to complete at least one qualification gunnery (tables V though VIII) annually.

3. There will not be a major technological breakthrough and subsequent fielding of helicopter-launched weapons within the next ten years significant enough to warrant discontinuing the employment of the *Longbow*'s 30mm cannon, *Hydra 70* rockets, and *Hellfire* ATGMs.

4. Flight training for Army aviators will continue at USAAVNC. This training will include live-fire training for transitioning AH-64D *Longbow* aviators.

5. The United States will continue to employ the Army's conventional forces in the full spectrum of military operations, including peacekeeping and peace enforcement. These forces will include attack helicopters such as the *Longbow*.

6 USAAVNC will maintain proponency for developing and producing doctrinal and TTP manuals for Army Aviation USAAVNC will also continue to staff and revise those manuals according to TRADOC regulations As the TRADOC proponent, USAAVNC will continue to be responsible for developing training programs for new aviation systems.

7 Attack helicopter unit training programs in the foreseeable future will continue to focus on the attack mission engagement and destruction of enemy targets, albeit with a higher sensitivity to collateral damage Reconnaissance and security, surveillance, and other missions will be subsets of the attack mission

Delimitation

This study will focus on the training of the AH-64D *Longbow* attack helicopter crew and the suitability of that training considering the number and type of missions envisioned by Force

XXI. This analysis will not include a discussion of door gunnery from utility helicopters, nor will it discuss the quality of the concept known as armed reconnaissance.

It is reasonable to expect that the nation's leadership will not commit attack helicopters to environments in which armed conflict is unexpected. For example, it is not likely that *Longbows* would be used in disaster relief operations in the continental United States. Likewise, the appearance of attack helicopters in a particular theater may signal to belligerents that the United States is considering or preparing for direct combat action. Thus, the commitment of attack helicopters will likely be made at the strategic level, rather than at the operational level. If attack helicopters are committed, the use of their weapons will likely be tightly controlled by restrictive rules of engagement (ROE), depending on the level of conflict. The reasons for this may be numerous, including the desire to limit collateral damage during engagements.

The scope of this study is limited to conventional forces. Special Operations Forces and capabilities will not be discussed. The intent is to provide information through an analytical approach on the training and employment of conventional attack helicopter units. Special operations aviation forces normally conduct low-intensity, high-sensitivity, and clandestine operations. The equipment, tactics, and training are tailored to perform such missions.

CHAPTER 4

ANALYSIS OF

HELICOPTER GUNNERY TRAINING STRATEGY

The aviation unit commander must understand the tasks, conditions, and standards applicable to his aircraft-type in order to execute the helicopter gunnery training strategy, and he also must be aware of systems available to help him during that execution. These tasks, conditions, and standards, combined with resources, provide the framework for the commander to train his unit for combat. This chapter analyzes the state of the current helicopter gunnery training strategy by first reviewing USAAVNC gunnery manuals for clarity and conciseness. Second, the Army and USAAVNC support infrastructure will be analyzed to determine their utility for assisting the unit commander with the execution of the helicopter gunnery training strategy. Finally, guidelines for and the quantity of training resources available for use during training execution, particularly ammunition, will be analyzed.

Aviation's Gunnery Manuals

Chapter 2 of this thesis gave an overview of FM 1-140, *Helicopter Gunnery*, and how it fits into the helicopter gunnery training strategy. This section will provide details on the content of the manual, as well as its companion manual, ST 1-140-1, *Master Gunner Handbook*. This will include specific information on conducting helicopter gunnery training, as well as the utility of the information contained in the manual.

The current FM 1-140, published 29 March 1996 contains a great deal of technical information relating to helicopter gunnery, as well as information usable by the commander to assist in building a coherent unit helicopter gunnery training strategy. The first three chapters in the manual describe the general theory, definition of terms, and the physical layout of helicopter gunnery ranges. Also included are chapters on ballistics, munitions, crew warfighting, and engagement techniques. These chapters are generic in nature and are largely aircraft nonspecific. They provide all crew members a variety of information that will assist in successful engagements.

The weight of the manual is contained in the tasks, conditions, and standards for helicopter gunnery training. These tasks, conditions, and standards are organized into "tables" specifically for the AH-64A *Apache*, AH-1E/F *Cobra*, OH-58D(I) *Kiowa Warrior*, and utility helicopter door gunnery. The term "gunnery table" refers to an actual graphical table in FM 1-140 that specifies the type of target to be engaged, the range in meters to that target, ammunition load, specific weapon for the engagement, and the target effect standard for each engagement. Included with the tables are specific techniques to accurately assess the standards contained in the tables, as well as requirements for selecting the proper type of target for each engagement.[1]

There are a total of twelve numbered tables for attack helicopter gunnery, expressed as tables I through XII. Tables I, II, III, and IV are known as basic tables and evaluate the individual aviator. Tables I and II are used for initial weapons qualification. The tasks, conditions, and standards for these tables are contained in the USAAVNC or National Guard Bureau program of instruction and are not specified in FM 1-140. The primary reason for this is that ammunition for Tables I and II is not provided by the STRAC process; it is purchased for qualification training from a separate account. Because the amount of money is constantly evolving for POI ammunition (unlike STRAC), this flexibility is required to ensure that students are able to graduate from aircraft qualification courses during periods when ammunition is limited for live-fire training.[2]

Since Tables I and II are scored by the instructor pilot, there is a great deal of flexibility given to the commander for the execution of these tables.

Units conduct Tables III and IV for prequalification training and the commander's evaluation of newly assigned aviators. Like Tables I and II, Tables III and IV are individual tables evaluated by a unit instructor pilot. For *Apache*-equipped units, instructor pilots use the Combat Mission Simulator (CMS) to conduct this training. *Kiowa Warrior*-equipped units receive ammunition to conduct this training because there is currently no compatible OH-58D(I) simulator. Commander's use these tables to assess the abilities and potential of the aviator, and for example, his performance can determine whether he should be assigned to the front-seat or back-seat of the crew station of the *Apache*.

Intermediate tables are Tables V-VIII. Units conduct these tables at least once annually to evaluate crew, rather than individual performance. Table V allows the commander to assess crew gunnery competency prior to live-fire gunnery. Through a series of gunnery exercises, written tests such as the Helicopter Gunnery Skills Test (HGST), and performance-oriented assessments, the commander can determine crew readiness. Table VI is the first live-fire table; it allows the crew to calibrate and verify the function of their helicopter's weapons systems prior to qualification. Tables VII and VIII are the qualification tables. Table VII is a live-fire dress rehearsal for Table VIII. Table VII has day and night exercises, and tasks, conditions, and standards very similar to Table VIII. When the crew completes Table VII, the commander determines, based on their performance, whether they will continue to Table VIII or return for retraining.

Table VIII is the annual qualification table. The table contains both day and night exercises and determines whether the crew is qualified as combat ready. Conduct of the table is mandatory per TC 1-210. There are some specific rules concerning the conduct of Table VIII, and

commanders are responsible to ensure compliance with FM 1-140. These rules include the requirement for a DA-approved scoring device to objectively evaluate target effect.[3]

Tables IX through XII are known as advanced tables. These tables integrate live fire into multiaircraft, tactical scenarios. Based on the unit's MTP and METL, the commander can tailor these tables to address certain aspects of his overall unit training plan. Normally, only Tables X and XII are resourced for live fire. Aviation does not require an advanced table qualification by the unit, unlike the Armor Branch.[4] Tables I-VIII are generic in the sense that the exercises are the same for all attack helicopter battalions, Army-wide. While FM 1-140 allows the commander the latitude to apply a tactical scenario to basic and intermediate tables, the USAAVNC doctrine writers view them as marksmanship exercises for the individual aviator and attack helicopter crew.[5] In contrast, advanced tables are very specialized exercises. While the tasks and standards for the engagements stay the same as during intermediate tables, the commander has latitude to set specific conditions for the tables. Because the unit commander dictates the scenario, the unit's crews have the opportunity to demonstrate the skills they were evaluated on during Table VIII, as well as collective, unit skills that are assessed continually during the year as part of the commander's METL assessment. Advanced tables also give the commander the ability to evaluate subordinate commanders during a tactical live-fire scenario. Thus, advanced tables are the linkage between helicopter marksmanship, unit METL training and assessment, and unit command and control.

The attack helicopter commander builds the advanced-table scenario based on the doctrinal principles in FM 1-112, *Attack Helicopter Battalion*. This manual gives the baseline doctrine for the employment of attack helicopters in combat. Given a specific mission or geographic area of interest, the commander selects those tasks that best reflect and train his METL tasks. For example, a commander whose unit routinely trains for an antiarmor mission facing a known threat

may integrate armor silhouettes on the range with radar emitters that mimic the threat's air defense systems. This would allow the commander and staff to build an operations order and intelligence product that would simulate those present in an actual wartime scenario. Because of this level of integration, advanced tables allow units to practice their multi-helicopter TTP under live-fire conditions in a controlled, peace-time environment.

Each gunnery table contains ten tasks (except for Tables V and VI). The standard for each task is assessed on a GO or NO-GO basis.[6] For example, the *Apache* tables consist of three cannon engagements, three rocket engagements, and four *Hellfire* engagements.[7] To receive a GO on a gunnery table, the crew must successfully complete seven of the ten tasks. In addition, the crew must satisfactorily complete one engagement for each weapon system. This scoring is critical for Table VIII because it ensures that the qualifying crew has shown proficiency in all of the helicopters weapons. An examination of the tables reveals that each of the weapons engagements are classified as short, medium, or long range. There are a minimum and maximum range to target distances for each task specified in the table; this gives the commander the latitude to place targets to fit the geography of the local live-fire facility, while meeting the requirements of the table.[8]

There is another component to scoring that provides a numerical score to the gunnery table. This component engagement time assesses the amount of time the crew requires to successfully engage the target. Specific criteria are included in FM 1-140 for the assessment of the crew's engagement time.[9] Using the engagement time point calculation sheets in FM 1-140, the designated scorer determines a numerical score for each task the crew completes. The times on the sheets, expressed in seconds, are based on specific weapon's system characteristics, times of flight, and crew coordination. Each of the ten table tasks are worth 100 points each, for a possible table total of 1000 points. The crew must receive at least 700 of 1000 points available for the

table (derived from engagement time) in addition to receiving a GO (based on the actual target engagement) on at least seven of ten tasks to certify on the table.

As a companion to progression through tables, there are also a series of gates the individual crewmember and crew must complete during the progression. A helicopter gunnery gate is a task or tasks grouped in a training event that a soldier or unit must perform to standard before progressing to more complex tasks or events. Gates allow commander to evaluate the effectiveness of training and assess whether the unit is ready for more complex training.[10] There are a total of six gates associated with the helicopter gunnery training program outlined in FM 1-140. There are two individual gates (Gates 1 and 2), three crew gates (Gates 3, 4, and 5), and one unit gate (Gate 6). The following outline the helicopter gunnery gates: *Gate 1:* Tables I and II; *Gate 2*: Tables III and IV; *Gate 3*: Table V; *Gate 4*: Table VI; *Gate 5*: Table VIII; and *Gate 6*: Table X. As stated before, each table must be passed successfully to progress to the next gate. The gates, along with the tables, allow a systematic progression for the unit's crewmembers through gunnery training and evaluation.

ST 140-1. A companion manual to FM 1-140 is ST 1-140-1, *Master Gunner Handbook*. This manual is the blueprint for the aviation Master Gunner Program first documented in the Interim Change to TC 1-140, dated 19 March 1993.[11] The concept for the Master Gunner was similar to that used by the armor branch: a gunnery expert (in aviation's case, a warrant officer rather than an NCO) that helped administer the commander's helicopter gunnery program. This initiative was in response to a perceived lack of emphasis in units on gunnery training. The interim change recommended that unit commanders establish an additional duty of Master Gunner. The criteria established in the interim change for the Master Gunner position is also present in FM 1-140.

After gunnery conferences at USAAVNC in 1993 and 1994, and an analysis of the 1995 STRAC survey, USAAVNC released the draft *Master Gunner Handbook* in November 1995.[12] According to the USAAVNC gunnery subject matter experts (SMEs), the response had been very positive from field units, with little constructive criticism received as of November 1996, one year after its release. Although the handbook was initially conceived as companion to a Master Gunner course at USAAVNC, it is now a "how to" book for the additional duty position in attack helicopter-equipped units. Because the manual is a special text (ST), it is not available through the regular Army publications system; it is only available from the Directorate of Training, Doctrine, and Simulation (DOTDS) at USAAVNC. According to DOTDS, the handbook will be made available for downloading on the USAAVNC World Wide Web page.[13]

Analysis. Compared to similar doctrinal manuals, FM 1-140 and ST 1-140-1 (DRAFT) are concise and clearly written manuals. As with all doctrinal manuals produced by USAAVNC, the manual is written assuming the reader has an eighth-grade reading comprehension level.[14] Subjectively, the level of detail is such that an individual who has no knowledge of helicopter gunnery could read these manuals and gain an understanding of how to build and conduct a helicopter gunnery training program.

To consider the content of the manuals and program construction, three criteria were used. These criteria were: the principles found in FM 25-100, *Training the Force*; the findings of the 1989 RAND AH-64 crew effectiveness study[15]; and flexibility in the program available to the commander.

First, FM 25-100 is the capstone training manual for the Army. It contains the overarching principles for planning, executing, and assessing training. It provides authoritative foundations for individual, leaders, and unit training in preparation for combat. In the preface to FM 25-100, then Chief of Staff of the Army General Carl E. Vuono states that every senior leader

is expected to know, understand, and apply the concepts in FM 25-100. The first concept worthy of discussion is the use of appropriate doctrine. FM 25-100 states:

> ...standardized doctrinal principles provide a basis for a common vocabulary and for military literacy across the force. In units, new soldiers will have little time to learn nonstandard procedures. Therefore, units must train on peacetime training tasks to the Army standards contained in mission training plans (MTPs), battle drill books, solder's manuals, regulations, and other training and doctrinal publications.[16]

As mentioned previously, standardizing tasks, conditions, and standards in FM 1-140 has numerous benefits for organizations, as articulated in FM 25-100. There are also three other key principles of training addressed by FM 1-140. These include:

Train as You Fight. FM 1-140s integration of tactical scenarios into gunnery training allows the commander to train and assess his unit's crews based on both technical and tactical criteria. In addition, the target arrays and ranges to target are doctrinally correct in accordance with FM 1-112. Based on USAAVNC doctrinal manuals, the tasks, conditions, and standards in FM 1-140 reflect the methods required to properly execute attack operations in a combat situation.

Use Performance Oriented Training. The process of gunnery training is focused on continuous training and evaluation. This hands-on approach includes the TSTT[17], CMS, and other TADSS in addition to live-fire gunnery.

Train to Challenge. The combination of target effect and engagement time standards, plus day and night exercises for both simulator and live-fire gunnery demands that the individual crewmember, the crew, and the unit to apply careful, deliberate decision-making throughout the exercise.

Second, a RAND study conducted in 1989 studied the training effectiveness of five AH-64 battalions stationed at the same installation. The evaluated tasks in the study included Aircrew Training Manual (ATM) gunnery tasks, with an emphasis on day and nigh target acquisition. This

study showed, that with a combination of simulator and aircraft training, the commander can train and sustain proficiency better than with aircraft training alone. Additionally, it showed that a battalion with a coherent training program is more effective against targets with a high target location error (TLE)[18] than those without. This is especially relevant if *Apaches* are employed in precision, deep operations; a better trained unit will have a better chance of actually finding the targets to engage.

The systematic approach to training found in FM 1-140 addresses all gunnery tasks, from target acquisition to target engagement. For example, the engagement times used to score gunnery tables takes into account target acquisition and crew coordination -- that time required for the crew to decide what they see, decide where it is, and decide whether or not to engage it. Based on this level of assessment and the conclusions of the RAND study, the methodology used in FM 1-140 is correct for training attack helicopter crews.

Third, the commander has a great deal of flexibility in building the unit training program. This is in keeping with the tenets of FM 25-100 which states that the commander is the unit's primary trainer. The flexibility built into the program allows the commander to tailor the training, within limits, to meet his unit's specific training needs. This flexibility falls into three broad categories. They are: live fire variances, advanced table scenarios; and resourcing. Each category is discussed below.

Live Fire Variances. According to Appendix B, FM 1-140, "Commanders may vary the engagement sequences, conditions, and target arrays within the tables to meet mission training requirements or to fit resource constraints such as range layout."[19] While the manual also stipulates that the modified engagement should be as challenging as the original one stated in the table, this gives the commander the ability to build a credible gunnery training range on complexes with limited targets or space.[20] The tables themselves afford the commander flexibility. For

example, the short, medium, and long engagements mentioned earlier allow the commander to fit the engagement to a particular target array. For example, instead of mandating a 1250 meter cannon engagement for task, which may or may not fit a particular range complex, the table allows an engagement of at least 1000 meters and no more than 1500 meters. This variance allows flexibility while maintaining the character of the engagement.

The commander also has flexibility in the evaluation of engagement time. Appendix C, FM 1-140, allows commanders to add ten seconds to the engagement time standard for ranges with masking terrain.[21] As noted earlier, there are many variables between Army range complexes. Some range complexes are devoid of vegetation, while some are nearly covered completely with trees and shrubs. Based on his assessment, the commander may elect for his crews to use tactical movement techniques to occupy the firing position, unmask, acquire the target, engage, and remask. Again, this allows the inclusion of a tactical scenario into the conduct of the range exercise, or fairly assess engagement time on a range with difficult terrain or a great deal of foliage.

Advanced Table Scenarios. There are no mandated advanced table scenarios in FM 1-140; rather, the included scenarios are examples, presented for both attack helicopter and cavalry units. While the advanced tables are for training and evaluating platoons and companies, they are METL-based and are focused on distribution of fires and unit engagement techniques. While two of the advanced tables have ammunition allocated (Tables X and XII), they are not required to be objectively scored using an AWSS or other scoring device. This flexibility allows the commander many options for conducting advanced tables. However, the true purpose for advanced tables is to allow the commander to inject uncertainty and chaos into a collective, live-fire training event. The end state for advanced tables are crews and leaders capable of thinking and reacting during high-stress, unpredictable situations like those that are present during combat.

Resourcing. While FM 1-140 was written primarily from an unconstrained resource perspective, there are a number of techniques employed to help the commander conserve resources. First is Combat Mission Simulator (CMS) Gunnery. For the *Apache*-equipped unit, Tables III and IV are completed in the CMS. This allows the commander to assess the aviator's capabilities prior to live-fire gunnery without expending the associated costly resources. By using the CMS's imbedded Gunnery-Conduct of Fire Exercise (G-COFT),[22] the commander can conduct Table III, IV, and V gunnery continuously throughout the training year. This training and assessment has the potential to increase the tempo of the live-fire range as well as decreasing OPTEMPO costs.

The commander also has an option for crews to validate on Table VII, skipping Table VIII and preserving the resources. Validation is the process of ensuring the gunnery crew can meet the Table VIII standard, thus validating the results of the last range.[23] There are several rules governing validation and the conduct of the validation table.[24] However, this allows the commander to harvest, or preserve ammunition for additional training and live-fire remediation for crews who fail to qualify.

In comparison to FM 1-140, ST 1-140-1 has no mandated requirements. It is a companion manual to FM 1-140. According to USAAVNC, the ST contains detailed information that may not be applicable to the average crew member.[25] A thorough examination of the ST shows that there is information on training programs, assessment, and helicopter ammunition available. The ST is clearly aimed at a narrow segment within the attack helicopter battalion, and its distribution using the Internet and classes at USAAVNC is appropriate.

Based on these criteria, FM 1-140 and ST 1-140-1 present a coherent and executable training plan. The level of detail, in stark contrast to the previous TC 1-140, enables a high level of standardization between aviation unit gunnery programs Army-wide. If executed by unit commanders to standard, this level of standardization may produce the benefit of reducing resource

requirements by providing consistent, similar gunnery training between units and the training base. That consistency would prevent crewmembers from having to relearn gunnery techniques after transferring to a new unit. In addition, the program articulated in the manuals provides the commander a great deal of flexibility in the execution of his program.

Support Infrastructure

TRADOC schools have an infrastructure of civilian and military personnel to produce and manage training programs. This infrastructure not only produces training materials such as field and TTP manuals, but also has assigned training developers. These training developers are integral to the identification and articulation of requirements for both weapon systems and their associated training devices. The infrastructure contains institutional knowledge; continuity is provided by DA civilians whose work history are more stable than their military counterparts. That is, they stay in their jobs for more than twelve to twenty-four months, and they have the opportunity to see a project progress from concept to fielding. This infrastructure is in place to varying degrees at all TRADOC centers, and the support provided to field commanders also varies greatly. In this section, the support infrastructure at USAAVNC will be analyzed and compared to one with a history of commitment to gunnery excellence: the US Army Armor Center (USAARMC) at Fort Knox, Kentucky.

USAAVNC. USAAVNC, located at Fort Rucker, Alabama,[26] is commanded by a major general, and is organized with two aviation brigades and two directorates. The USAAVNC agency responsible for helicopter gunnery issues is the Directorate of Training, Doctrine, and Simulation (DOTDS). DOTDS is responsible for many important aviation programs. The following is the DOTDS mission:

> Responsible for the development and implementation of Army Aviation Training Development, doctrinal literature, gunnery and aircraft survivability equipment issues, and the Aviation Simulation Strategy. We are the aviation executive agent that manages all

> aviation training aids and devices, simulations and simulators and ensures standardization and quality assurance throughout the force. We are directly responsible for orchestrating the Total Army School System for United States Army Aviation Center (USAAVNC).[27]

This mission includes many tasks relating to helicopter gunnery. These include producing aviation gunnery doctrine and TTP manuals, serving as the aviation user representative and configuration managers for aviation simulators, and serving as the point of contact for gunnery issues for USAAVNC. Being that USAAVNC is the aviation proponent, DOTDS is responsible not only to TRADOC, but the entire active and reserve aviation force.

DOTDS, commanded by a colonel, consists of four subordinate divisions, each commanded by a lieutenant colonel. These divisions are Doctrine Division, Gunnery and Aviation Systems Division, Training Division, and Warfighting Futures Division. To see how each of these divisions impact helicopter gunnery, the mission of each is shown below.[28]

Doctrine Division. The Doctrine Division's mission is to: (1) prepare, staff and distribute aviation doctrine and ensure incorporation into future and joint doctrine; (2) provide doctrinal SME support to the Directorate for USAAVNC; (3) develop, implement and supervise the Multi-Media, Distance Learning Modernization Plan; and (4) manage the Automated Systems Approach to Training

Gunnery and Aviation Systems Division. Gunnery and Aviation Systems Division serves as the DOTDS and USAAVNC representative and point of contact on all matters concerning aviation gunnery, aviation training aids, devices, simulators, and simulations, electronic combat, aircraft/aircrew survivability equipment and new systems. According to the DOTDS Internet site this mission also includes STRAC, Aviation Branch Helicopter Gunnery Program Management, and the Master Gunner Program.

Training Division. Training Division's mission is to: (1) serve as executive agent for USAAVNC Total Army School System (TASS) Program; (2) conduct individual training analysis

and design IAW the Systems Approach to Training (SAT) process; (3) provides subject matter expertise to manage, write, review, and coordinate aviation training support materials to include designated Total Army Training System Courseware (TATSC), Programs of Instruction (POI), Soldier's Training Publications (STP), and Aircrew Training Manuals; and (4) exercise staff management of the CG's "HOT LINE" Program.

Warfighting Futures Division. Warfighting Futures Division's mission is to: (1) exercise oversight of the Aviation Test Bed (AVTB) preparation for and conduct of Advanced Warfighting Experiments (AWE) and technology demonstrations; (2) integrate hardware/software battlefield digitization capabilities to support aviation; (3) develop and integrate future battlefield digitization capabilities to support aviation Force XXI initiatives with near term focus on EXFOR; (4) assure accurate aviation participation in AWE, Advanced Technology Demonstrations (ATD) and Advanced Concept Technology Demonstrations (ACTD); (5) increase aviation warfighting capabilities; (6) maintain technology growth at USAAVNC and AVTB; (7) participate in and support AWE LIVEXs; (8) support AWE, ATD, ACTD execution and develop lessons learned, TTP, TSP and AARs; (9) plan, coordinate, develop and implement TF XXI aviation EXFOR training; (10) develop a technology foundation to support Army Aviation using Distributive Interactive Simulation (DIS); (11) be responsible for Army Aviation virtual and constructive simulation development and the integration of requirements for models and simulations; (12) monitor basic and advanced course training in the AVTB; (13) develop future training strategies based on emerging doctrine and tactics, techniques, and procedures in AWE and ATD; (14) coordinate with government agencies, industry, and academia to ensure technology integration efforts; (15) provide input to the Warfighting New Equipment Training (WARNET) Pilot program developed by TRADOC; (16) provide input to the Standard Army After Action Review System (STARRS) initiative to ensure that aviation lessons learned are incorporated into the Army

Training Digital Library (ATDL); and (17) operate the Army Aviation Warfighting Analysis Laboratory in support of classified and unclassified simulations studies relevant to Army Aviation on the joint battlefield.

All of these organizations have broad missions. Of these DOTDS organizations, the Training Division's Deficiency Analysis Section (DAS), also known as the Aviation Hotline has the broadest. The mission of DAS, as stated on the USAAVNC Internet home page, is to "Review and resolve Army Aviation Deficiencies identified by USAAVNC, the Combat Training Centers (CTCs) and Army Aviation Units."[29] Acting as the USAAVNC agent, the DAS not only has the charter to review training and doctrinal deficiencies, but also solve those deficiencies. This clearly shows that USAAVNC is dedicating assets to assist field commanders with their programs. A logical conclusion is that assistance is available from USAAVNC for helicopter gunnery training in field units.

Because it is clear that USAAVNC has a commitment to assisting field commanders with helicopter gunnery, an examination of the mission statements for DOTDS and its subordinate divisions shows that each division has some responsibility for helicopter gunnery-related subject matter. However, the responsibilities are not clearly delineated between the divisions. For example, Doctrine Division is responsible for writing, staffing, and fielding both FM 1-140 and ST 1-140-1, but Gunnery and Aviation Systems Division (GASD) is the point of contact for both. Additionally, the writers who are responsible for integrating simulation into gunnery manuals belong to Doctrine Division. The training developers charged with developing materiel requirements relating to system and non-system training devices[30] are split between branches in GASD. Training doctrine is also extended to the Warfighting Futures Division. This division is responsible for the accurate modeling of aviation weapons systems in simulation, as well as writing and coordinating training plans for future systems.

While there are some blurred lines of responsibility based on mission statements and organization, it is clear that the Gunnery and TADSS Branch of GASD works the bulk of gunnery issues in DOTDS. As of early-February 1997, there were two Army aviation warrant officers and five civilians assigned to work "all matters concerning aviation gunnery, aviation training aids, devices, simulators, and simulations."[31] Interestingly, the one civilian in GASD that was responsible solely for gunnery issues and STRAC (specifically, STRAC, Aviation Branch Helicopter Gunnery Program Management, and Master Gunner Program)[32] learned in January, 1997 that his job position had been eliminated in the ongoing TRADOC downsizing. This individual has worked on generally the same projects since 1988,[33] and there is no individual identified to assume these responsibilities.

USAARMC. The United States Army Armor Center (USAARMC), located at Fort Knox, Kentucky,[34] has responsibility for the Army's tank gunnery training strategy. USAARMC also prepares doctrinal materials for Bradley Fighting Vehicle gunnery; however, the focus of this analysis is on the Armor Branch's primary weapon system, the M1 *Abrams* tanks.

The USAARMC organization is similar to that of USAAVNC. There are separate organizations commanded by colonels responsible for both training and doctrine. The USAARMC organization that is the counterpart to the USAAVNC DOTDS is the Directorate of Training and Doctrine Development (DOTDD). This directorate, commanded by a colonel, has a number of responsibilities tied directly to tank gunnery. The three assigned divisions, each commanded by a lieutenant colonel (or equivalent), are responsible for the following:

Armor Magazine Division. Responsible for producing *Armor* magazine, the branch professional journal.

Training Development Division. This division contains five branches and has major input for the Tank Gunnery Training Strategy. Major functions include development of the Armor

STRAC strategy, development of the Armor Combined Arms Training Strategy (CATS), and development of USAARMC courses of instruction. This division combines the resource requirement functions for the gunnery training strategy into one organization.

Doctrine Division. Responsible for the Armor Branch doctrinal manuals, from individual soldier manuals to brigade doctrine. Responsibilities include producing special texts (STs) and instruction during the Armor Precommand Course (PCC). This division incorporates lessons learned and new technologies into branch doctrine, as well as answers questions relating to doctrine and training issues in field units. The division contains four branches. Of the four, Crew Gunnery Branch, headed by a captain, is most responsible for Armor branch gunnery manuals.

Crew Gunnery Branch has eight soldiers assigned, all in the rank of staff sergeant or sergeant first class. These sergeants are Master Gunners,[35] experts in tank gunnery. The Master Gunners are responsible as SMEs in their particular weapon system. For example, the Crew Gunnery Branch's Master Gunners provide expertise not only for the widely fielded M1A1 tank, but also for the newer M1A2 tank and M3 Cavalry Fighting Vehicle. This diverse expertise is applied during the Branch's process of publishing the following Armor field manuals: FM 17-12-1-1, *Tank Combat Tables--M1*, volume I; FM 17-12-1-2, *Tank Combat Tables--M1, Volume II*; FM 17-12-8, *Light Cavalry Gunnery*; FM 17-12-1-TCEEP, *TCE Exportable Packet*;[36] and FM 17-12-7, *Training Devices Appendix*. The Crew Gunnery Branch also has three civilians assigned to assist in the production of manuals: one editor, one visual technician, and an Operations Research Systems Analyst. Additional responsibilities include subject matter expert support for Unit Conduct of Fire Trainer (UCOFT), Close Combat Tactical Trainer (CCTT), and other TADSS associated with tank gunnery, as well as analysis on the amount of resources, including ammunition required for training and evaluation.[37]

Analysis. Prior to the analysis, some important distinctions exist between the armor and aviation branches. First, USAAVNC publishes only one gunnery manual, while USAARMC publishes five. Second, every officer in Armor branch is a "tanker"; that is, they are all trained in basic gunnery skills, and conduct live fire gunnery during their Officer Basic Course (OBC). This is in contrast to Aviation, where only the portion of officers that are selected for and complete the AH-64A, OH-58D (I), or AH-1 qualification course[38] at USAAVNC receive gunnery training. Because Aviation is charged with executing combat, combat support, and combat service support missions, the majority of the branch's officer corps never participate in attack helicopter gunnery training. Finally, non-commissioned officers do not serve in warfighting positions in Aviation Branch; that is, they are not in command of combat systems as they are in the Armor branch. Aviation warrant officers fill roughly the equivalent positions filled by noncommissioned officers in the Armor branch. This difference in grade of the gunnery SMEs between Armor and Aviation branches translates into different assignment considerations. These differences, particularly the intensive management of AH-64 aviators, translates into increased difficulty at USAAVNC concerning assignments to DOTDS. This fact, coupled with shortages of AH-64 aviators[39] throughout the Army makes those assignments to gunnery SME positions difficult. As an example, as of April 1997, DOTDS at USAAVNC did not have a Master Gunner assigned.

Comparison of the USAAVNC and USAARMC gunnery infrastructures indicates that both organizations are capable of performing the functions mandated by TRADOC, including literature production and instruction. But the superior capability for assisting the unit commander, updating training publications, and incorporating new weapons systems into the gunnery training strategy resides at USAARMC. Using the superior USAARMC gunnery infrastructure as the standard, the following is an assessment of the capabilities and limitations of the USAAVNC following functional areas: doctrine, organizational structure, and personnel assignment policies.

Doctrine. First, USAAVNC does not have SMEs assigned to updating and writing doctrine. As of early February, 1997, there were no AH-64-rated aviators assigned to the USAAVNC DOTDS Doctrine Division. In addition, there were no AH-64D *Longbow*-rated aviators assigned to DOTDS, even though the first unit equipped (FUE)[40] will receive these sophisticated aircraft in the summer of 1997. Second, USAAVNC does not share the method of producing a specific gunnery manual for each aircraft type (i.e. a separate gunnery manual for the AH-64A, AH-64D, OH-58D(I), and AH-1). While likely increasing the budget at USAAVNC, it would allow the size of the manual to be reduced, as well as allow the SME writing the manual to focus the information in the manual by aircraft- and unit-type. This would reduce the generic nature of the current FM 1-140 which currently includes gunnery TTP for all armed helicopters, including utility helicopter door gunnery. Third, USAAVNC has very few editors available to complete doctrinal manuals or visual arts technicians, also known as illustrators. In early 1997, there were only three editors and no visual arts technicians assigned to USAAVNC to edit all doctrinal, training, and instructional manuals produced by Aviation Branch. According to DOTDS, the standard word processing software for manuals is Microsoft Word. Because the manuals are completely electronic, that is, no cut and paste is allowed for the graphics, illustrators are crucial to complete the graphics, or pictures contained in the manuals.[41] In their absence, graphics tasks fall to the actual doctrine writers and editors who receive no special training in these tasks. This is in contrast to USAARMC, which has editors and visual arts technicians assigned to each branch.

Organizational Structure. Because gunnery, TADSS, and Aircraft Survivability Equipment (ASE) functions fall under the same DOTDS division (GASD) at USAAVNC, several unlike processes compete for resources. The overall effect of this combination may be the decreasing emphasis on live-fire helicopter gunnery. Both TADSS and ASE have Army-wide

missions requiring that SMEs travel to various locales for simulator configuration management and new equipment training. Because these missions are required by USAAVNC and TRADOC, the elective, non-mandatory function that is helicopter gunnery can easily be seen as the bill-payer, both in temporary duty travel funds and manning. As discussed earlier, the downsizing of TRADOC will eliminate the sole helicopter gunnery and STRAC SME position in GASD. However, this will have little short-term (less than two years) effect because the only product related to helicopter gunnery required for production by DOTDS is FM 1-140, which is produced by Doctrine Division.

Personnel Policies (SME Assignment). Based on numerous contacts with Aviation officers, there is a clear perception that an assignment to USAAVNC is not career enhancing. Because of this perception, many Aviation commissioned and warrant officers will volunteer for nearly any assignment to prevent being assigned to USAAVNC. During an interview with an Attack Company Trainer at a Combined Training Center, the subject of assignments was discussed.[42] According to this officer, an experienced AH-64 aviator, US Army Total Personnel Command[43] was considering assigning him to USAAVNC. He was very upset with the prospect, and he believed that his military record was strong enough to prevent that assignment. Unfortunately, a officer with his experience is the type needed at USAAVNC, particularly for assignment working gunnery issues.

This is in contrast to the personnel policies of Armor Branch. According to CPT Tom Cook, Chief of Gunnery Doctrine Branch at USAARMC, an assignment to Fort Knox is not one that is actively avoided by Armor officers. Because of this, top officers are assigned to Fort Knox to serve in a variety of positions. Armor Branch also actively pursues Project Warrior, a program in which officers who serve as observer/controllers at a Combat Training Center are assigned to

USAARMC upon completion of their tour. This ensures the capturing of lessons learned and trends by the doctrine writers at the school.

In short, an assignment to USAARMC is not viewed as a "career-ender" by Armor officers. The perceptions that surround an assignment to USAAVNC can be remedied by the senior leadership in Aviation. Through aggressive recruiting and assignment policies, the top Aviation officers could return to USAAVNC and contribute to the branch without fear of crippling their careers.

Conclusion. USAARMC has dedicated more resources toward and placed more emphasis on gunnery than USAAVNC. Active participation by the USAAVNC leadership is required to revive the premium placed on the combat readiness of attack helicopter crews--particularly the ability to engage and destroy enemy targets. This ability starts at the school, and the revival of an emphasis on gunnery must also start at the school.

Training Resources

As stated earlier in this chapter, the commander combines the tasks, conditions, and standards provided by USAAVNC with resources to execute the training program. The primary resources required for helicopter gunnery training are gunnery ranges, ammunition, flying hours, spare parts, and time. This section will discuss the resource challenges facing the commander, and the ability to execute the training program within current resourcing guidelines. Each major category of resources will be discussed independently.

Ranges. Helicopter gunnery training is normally conducted on Multipurpose Range Complexes (MPRCs). MPRCs are tracts of land, normally 1,000 meters wide and 4,500 meters long, equipped with remote-controlled plywood target silhouettes. These silhouettes, which raise from a horizontal to vertical position on the electronic command of the range operator, serve as

targets for engagement by the attack helicopter crew. The targets are equipped with sensors that register target effect when engaged with live ammunition. In addition, the targets can be heated to present a realistic infrared signature during operations in darkness. MPRCs are also used for tank and Bradley Fighting Vehicle gunnery. The MPRCs layout is explained in detail in TC 25-8, *Ranges*, as are the standards for target placements. Interestingly, TC 25-8 contains a diagram of a helicopter gunnery range that is incompatible with the standards in FM 1-140, and should be updated to reflect the revised standards. [44]

The unit commander is responsible for scheduling training periods on the MPRCs. Depending on the installation, competition for range time between units can be keen. FM 1-140 states that the average attack helicopter battalion requires two continuous weeks on a range to complete qualification gunnery programs (Tables VI through XII). The range is normally scheduled through the installation range control officer or division/corps G3. These agencies control the range time, and ensure that all units using the MPRC have adequate time to complete their qualification.

A subset of ranges is scoring systems. The Army currently uses two systems to objectively score aviation gunnery. The first system is the Aerial Weapons Scoring System (AWSS), manufactured by Cartwright Electronics, Inc. The AWSS is a system of computer controlled sensor that can accurately score cannon and rocket engagements. These systems are owned by the Army and are contractor operated.[45] The Army owns a total of three systems. Two are mobile systems serving the continental US and Korea, and the other is semi-permanently stationed at Grafenwohr Training Area (GTA), Germany. The AWSS is scheduled through the firing unit's Major Army Command (MACOM) and must be used for Table VIII qualifications to be valid. The second system is the Television Ordnance Scoring System (TOSS), manufactured by Arcata Associates, Inc. The Army currently owns one TOSS, a US Air Force system originally

developed to score crew bomb-dropping accuracy. This system is permanently installed at the Western Army Aviation Training Site (WAATS), Marana, Arizona, supporting gunnery conducted by both active and reserve attack helicopter units at their Gila Bend range. Both the AWSS and the TOSS are being modified to objectively score semiactive laser (SAL) Hellfire missile engagements; neither currently do so. SAL Hellfire engagements are subjectively scored by unit instructors.[46] The instructors view the crew's gun camera videotape of their engagement and assess whether they believe the missile engagement would have been successful.

This requirement for a scoring system requires the unit to forecast training far enough in the future to ensure that the scoring system is available during the scheduled range period. In addition, the unit must have an operational *Apache* video tape player and monitor[47] to view the gun camera tapes because the *Apache's* tapes are not compatible with standard VHS video cassette recorders and televisions.

Ammunition. As mentioned in chapter 2, ammunition is provided to attack helicopter units through a requirement in DA Pam 350-38, *Standards in Weapons Training*, also known as the STRAC manual. According to Army Training Support Center, a new STRAC strategy was approved in 1996 and will go into effect on 1 October 1997.[48] This strategy effects all units, regardless of helicopter type, however, the major change will be in the AH-64A strategy. This strategy resources ammunition by airframe assigned to the unit, not by crews assigned.

Active duty AH-64 units will receive a total of 114 training rockets (92 PD, 22 MPSM) and 880 30 mm cannon rounds. Reserve component AH-64 units will receive a total 92 training rockets (76 PD, 16 MPSM) and 550 30mm cannon rounds. These numbers represent an actual increase in quantity above the FY 1993 strategy, due in large part to the dollar savings realized during the post-Desert Storm downsizing of the aviation fleet.

According to the STRAC proponent at USAAVNC, the FY 1998 STRAC strategy is superior to the previous STRAC for several reasons. First, it preserves rockets for evaluation of firing pairs of rockets (as they are employed in combat), not single rockets. Second, it resources ammunition levels to allow reserve component AH-64 units to fire the same basic and intermediate tables as their active duty counterparts. Finally, it allows active component commanders the ability to conduct live fire advanced table training, a capability that was not resourced in the last STRAC.[49]

However, there are two major issues with the current STRAC that must be resolved. First, there is very little slack, or extra quantities of ammunition resourced to allow for crews who continually do poorly during qualification. Because there is little slack, a crew who does not qualify during their first attempt may not be able to qualify because sufficient ammunition may not be available for another attempt. The Armor community refers to this as remediation; the ability for the commander to give weak crews more than one attempt to qualify. The second issue is ammunition for crew turnover. As mentioned earlier, AH-64 units have experienced turnover in aviators at approximately 6.6 percent, above the Army average of 5 percent. This rate, coupled with increased turmoil in assignments driven by requirements in Korea (now with three AH-64 battalions) and the force in Bosnia, annual qualifications may not be enough to ensure combat ready crews.

This is another resource consideration required of the commander; the ability to manage ammunition to allow the maximum number of crews to remain qualified throughout the training year.

Flying Hours and Spare Parts. The amount of time aviation units are allowed to fly the assigned helicopters is an amount expressed as flying hours. The number of hours assigned to the aviation unit depends on a number of factors. These factors include known deployments, estimated

crew turnover, mission requirements, etc. and are articulated on requests to higher headquarters. Flying hour programs are funded by the Department of the Army, allocated by the unit's MACOM, and are intensively managed by all levels of command. A unit will normally receive enough flying hours to complete all required training based on historical estimates, as well as guidance contained in TC 1-210.[50] Through the 1990s, AH-64 units have received about 200 flying hours per aircraft per year. Combined with flying hours, the availability of spare parts for the helicopters, known as Class IX Air, impacts the amount of flying the unit's aviators complete. Again Class IX Air is funded by the Department of the Army and allocated by the unit's MACOM. By having the authority to allocate flying hours and Class IX Air dollars, the MACOM can allocate resources to higher priority units during periods of budget shortfalls, or rapidly shift resources in the event of a deployment, for example.

Flight Simulators. There are currently ten AH-64 *Apache* Combat Mission Simulators (CMS)[51]. These simulators support a total of 24 active and reserve component *Apache* battalions currently assigned to the Army. These simulators are full visual, virtual devices. Each feature an exact replica of both the front and back seat station of the *Apache* in separate enclosures. These enclosures feature a sophisticated, computer-controlled hydraulics system that accurately simulates the feel of the flight controls, as well as fuselage motion of the *Apache* in flight. The CMS allows engagement of numerous target types with the *Apache's* weapon, and onboard software accurately scores both gunnery skills and engagement timing using the FM 1-140 standards. A versatile simulator, the CMS allows aviators to train using day or night scenarios with varying weather conditions and aircraft malfunctions adjustable by the instructor/operator (IO) who accompanies the crew in the simulator.

Because of the fidelity, or realism of the CMS, current Army regulations allow aviators to conduct part of individual flight time minimums in the CMS. This time may include both day and

night missions. Also, the Gunnery Conduct of Fire (G-COFT) software imbedded in the CMS allows the commander to assess the readiness of crews for gunnery prior to expending resources. The CMS is a valued resource for the commander, allowing a great deal of training to be completed in the nearly risk-free virtual environment created by high-powered computers.

Time. As mentioned in chapter 2, time is likely the most precious resource for the commander. The Anacapa Sciences, Inc. *Army Aviation Ammunition and Gunnery Survey* in 1987 and 1988 clearly showed that time was a chief concern for the conduct of gunnery. Interestingly, the Anacapa Sciences survey also found that ranges and scoring systems were also a concern in the conduct of a gunnery training strategy. This concern may also be a subset of time because of the requirements to forecast these resources well in advance. The physical act of scheduling a range for a two week period, scheduling a scoring system for a two week period, and synchronizing your training calendar for that period up to one year in advance can present a significant challenge to the unit commander. This is especially true if the unit is assigned a rapid deployment mission, or a deployment is announced after arrangements have been completed for the range and the scoring system. Time is also a major consideration when estimating flying hours and Class IX Air. This may be expressed in a question similar to the following: what will the unit turnover be in the next 12 months, and how much additional time will be expended in training new-to-the-unit aviators?

Analysis. In the analysis of resources, the obvious question is whether there are too many, too little, or the proper amount to conduct training in accordance with the strategy described in FM 1-140? Specifically, are there enough ranges, ammunition, flying hours, spare parts, and time to complete this crucial training?

An analysis of each unit in the Army is impracticable for this study; however, there are systems in place to receive an assessment of the impact of resources on readiness. Therefore, to

properly assess the impact of resources on training, it is most feasible to use data from the system the Army uses to gauge readiness and resources: the Unit Status Report (USR). Battalion-level commanders are responsible to make monthly assessments of their unit's status in the USR described in AR 220-1, *Unit Status Reporting*. The commander assesses many aspects of his unit including equipment readiness, personnel readiness, training readiness, and an overall status, or "C-status" of his unit. C-status is a graduated scale, with C-1 being the highest status (ready for war in 14 days or less) to C-5 (not ready, unit reorganizing). Once completed, the report is forwarded through the chain-of-command, and is collated and analyzed in the Pentagon by the Army Staff. Each staff element is responsible for different portions of the USR. The training and training resource data is the responsibility of the Army's Office of the Deputy Chief of Staff, Operations (ODCSOPS). Using data from the USR, the ODCSOPS is able to determine not only the readiness of units, but also resource issues required to bring a unit to a combat ready status. Using this historical data, the ODCSOPS can make budgeting decisions and help forecast requirements for the future.

The last study completed focused on Aviation readiness was the 1995 STRAC evaluation conducted by the Army Training Support Center (ATSC), Fort Eustis. Although nearly two years have elapsed between the release of the report and this thesis, ATSC has continued to track the USR data, and reports that ammunition resourcing has remained at the expected levels. According to SMEs[52] at ATSC and ODCSOPS, the data in the draft report is still accurate and applicable to the present-day resource discussions. According to the STRAC Aviation Evaluation Findings (DRAFT), dated 21 April 1995 --

> Current resourcing levels have little impact on unit training levels. When asked if the standards outlined in DA Pam 350-38 had an effect on the Unit Status Report, 57 percent answered NO and 43 percent answered YES. CTS screening of the USR database during 1Qtr/2Qtr FY 94 showed two instances of aviation battalions reporting training ammunition (T-07) as a training constraint. The suspension[53] of rockets during the second half of FY 94 caused several battalions to make statements on the USR training comments card.

> Ammunition as a training constraint, however, continued to be reported overall as having none to only minor impact on training readiness in 98 percent of the time. CTS could find no instances of a battalion's C-status or Training level being downgraded due to ammunition constraints.[54]

Interestingly, the report also stated that eighty percent of units reported that gunnery training was adversely affected by external factors. These factors included post support requirements, range problems, shortages in personnel, time and funds, and major readiness exercises and alerts. This statement shows a clear connection to the 1988 Anacapa Sciences study which stated: while ammunition was available, resources such as ranges, scoring systems, and time were in limited supply for gunnery training. This connection is particularly interesting because between 1988 and 1996, USRs have not reflected these shortfalls; therefore, no significant resources have been allocated to overcome these shortfalls.

USAAVNC has issued guidance for commander concerning resourcing. In reaction to reduced training resources such as flying hours, ammunition, and repair parts allotted to a unit training program TC 1-210 states:

> Commanders are expected to manipulate available resources through imaginative and skillful managerial techniques. Within the given constraints, they are expected to maintain an appropriate level of combat readiness.[55]

While it may appear that the current helicopter gunnery training strategy does not have enough resources allocated to meet the goal of combat ready units, there is no objective data from aviation units to indicate that those resource shortfalls produce a decrement in readiness.

Summary

This chapter examined the current state of the systems in place to assist the commander in the execution of the Helicopter Gunnery Training Strategy. These systems include doctrinal

manuals and assistance from the proponent, USAAVNC. In addition, the availability and reporting of resources was examined.

To complete the look at the gunnery infrastructure, the Master Gunner at the National Training Center was contacted for a current assessment of gunnery skills.[56] Data collection and trend analysis are part of the Master Gunner's charter at the NTC, and data exists for CONUS-based AH-64 attack helicopter battalions that train at the NTC. This data collection occurs during unit training rotation when the Master Gunner views the *Apache* video tapes of engagements, visits the units at their field sites, observes their live fire training, and generally builds a "gunnery profile" of the unit. The current Master Gunner was assigned to NTC in February, 1996. He is an experienced AH-64A instructor pilot, and served at USAAVNC as an instructor for the *Apache* aircraft qualification course. He has a detailed knowledge of the USAAVNC infrastructure, the doctrinal manuals, and the resources required to conduct helicopter gunnery training. Based on his observations, specific gunnery trends noted at the National Training Center are divided into three broad categories: crew coordination, copilot/gunner technique, and unit collective gunnery techniques. The following are examples of these trends.

Crew coordination. Crew coordination, or the efficient communication between the two helicopter crewmembers in *Apache* units is very poor. This is important because *Apache* weapons engagements, particularly those using either rockets or Hellfire missiles, require actions by both crewmembers working in synchronization to be effective. A major shortcoming noted is that *Apache* crewmembers are generally not using a systematic method to engage targets. This manifests itself through confusion in the cockpit between crewmembers and slow, ineffective engagements. Another example of poor crew coordination is poorly understood weapons initialization procedures used during the helicopter's startup procedure. The Master Gunner agreed that while FM 1-140 explains crew coordination procedures in detail, their techniques are

not taught during the AQC at USAAVNC. Also, Aviation branch does not require assessment of crew coordination during gunnery evaluation, unlike Armor branch.[57]

CPG Technique. Target acquisition and tracking procedures by the copilot/gunner (CPG) are consistently poor. Because the bulk of the weapons controls are found in the front crew station of the *Apache*, the CPG must understand the procedures for weapons employment. Based on trends, CPGs do not have a good understanding of the advanced tracking features of the *Apache* to include proper use of image autotrack, manual tracking using linear motion compensation (LMC), and proper FLIR polarity management. In addition, target identification and fratricide are noted deficiencies among CPGs at the NTC. While CPG actions are evaluated during the ACQ at USAAVNC, the Master Gunner believes the skills are not being sustained and improved with unit gunnery training programs.

Unit Collective Gunnery. This term refers to the ability for the platoon and company to mass fires on a target, such as a moving armor company. The Master Gunner states that one of the biggest problems with *Apache* units at the NTC is the ability to coordinate and synchronize fires from the unit helicopters. He states that a unit of helicopters will arrive at the appointed position to engage the targets and regularly never fire a shot before their position is overrun by the enemy. In addition, he stated that the company fire distribution plan is seldom briefed or rehearsed before a mission. The result is a poorly planned and synchronized mission in which the attacking crews do not completely understand what they are supposed to be doing. He believes that this area is poor because it is not taught at USAAVNC, nor is it being adequately trained in units.

However, the Master Gunner has also observed that individual and unit skills improve dramatically during a four-week long NTC training rotation. He also stated that, while this learning trend is hopeful, units may not get a month of uninterrupted training prior to deploying to

a combat theatre. Based on the NTC's data, he assesses fundamental individual, crew, and unit gunnery skills as being generally poor across the Aviation force.

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[1] Appendix C of FM 1-140 gives specific guidance on the target silhouettes suitable for helicopter gunnery. These silhouettes are two-dimensional plywood targets, painted black, that are fitted to target lifters on the standard Army Multi-Purpose Range Complex (MPRC). These targets silhouettes include tanks (frontal and flank), personnel, armored personnel carriers, and trucks. US Army, FM 1-140, *Helicopter Gunnery* (Washington: Department of the Army, 1996), C-1.

[2] There was an attempt to add tasks, conditions, and standards for Tables I and II to the 1996 FM 1-140; however, a consensus could not be reached at USAAVNC on the contents of the tables. Ron Manning, USAAVNC, Telephone interview by author, 17 October 1996, Fort Leavenworth, KS.

[3] Chapter 1 of FM 1-140, *Helicopter Gunnery*, stipulates that Table VIII must be objectively scored by a DA-approved scoring system, and that subjective upgrades of scores is unacceptable. Also, commander's may elect for crews to "validate" on Table VII; that is if crewmembers may forego attempting Table VIII if they meet certain criteria. This criteria is: The crewmembers must occupy the same crew station as the previous gunnery in which he/she qualified (unless dual-seat designated), the crewmembers qualified on Table VIII during the preceding 12 months on an objectively scored qualification range, and the crew qualified on their first attempt on Table VII.

[4] The Armor Branch advanced table gunnery qualification is conducted usually by a platoon-sized element of four tanks. The table evaluates command and control, as well as fire distribution of the platoon. The current FM 1-140, *Helicopter Gunnery*, does not require objectively-scored multihelicopter gunnery.

[5] Ron Manning, USAAVNC, Telephone interview by author, 17 October 1996, Fort Leavenworth, KS.

[6] According to FM 1-140, *Helicopter Gunnery* (9-10), Table V has specific criteria for evaluation but no specific tasks; the unit commander must determine builds the tasks based on the observed level of training and METL assessment. Table VI requires engagements with each of the helicopter's weapon systems, with the accuracy and function assessed by the Unit Armament Officer.

[7] Of the four Hellfire missile engagements, three are autonomous and one is remote. During an autonomous engagement, the firing helicopter also provides laser guidance for the missile. During a remote engagement, the firing helicopter does not provide laser guidance; that is accomplished by either another helicopter or a ground-based laser designator.

[8] The short, medium, and long range criteria was constructed to fit the large variation of live-fire range facilities available for helicopter gunnery. Information gathered for the initial draft of FM 1-140 showed that units routinely conducted live-fire gunnery at multi-purpose range

complexes (MPRCs) designed for tank gunnery, unimproved impact areas suitable for artillery and mortars, and Air Force ranges designed for high performance jet gunnery. The only range designed specifically for helicopter gunnery is the Mollinelli Range Complex, Fort Rucker, Alabama. Ron Manning, USAAVNC, Telephone interview by author, 17 October 1996, Fort Leavenworth, KS.

[9] FM 1-140, *Helicopter Gunnery*, specifies in chapter 2 and Appendix C how to assess engagement time. These instructions include how to measure times on ranges with either pop-up targets or fixed targets. They also specify how to measure engagement time during running or diving engagements.

[10] FM 1-140 (1996), 2-8.

[11] The interim change to TC 1-140 was published by USAAVNC and used as the working document for the draft FM 1-140 published in December 1993. The interim changes was an add-in to TC 1-140; it updated standards and added a number of new initiatives. A working group convened at USAAVNC 23-25 February 1993 and formulated concepts that form the basis of the current FM 1-140; among these was the master gunner. US Army Aviation Center, *Interim Change to TC 1-140, Helicopter Gunnery* (Fort Rucker, AL: US Army Aviation Center, 1993), 4.

[12] Army Training Support Center, Fort Eustis, administered an aviation-wide survey in Spring 1995. The purpose of the survey was to gauge unit ammunition allocations and training resources available for helicopter gunnery training. The survey also featured a number of questions relating to the aviation master gunner, and the unit's perceptions of that concept.

[13] Ron Manning is the USAAVNC action officer responsible for placing the handbook in a downloadable form on the Fort Rucker Internet site. The Internet address is http://www-rucker.army.mil.

[14] Ron Manning, USAAVNC, Telephone interview by author, 6 February 1997, Fort Leavenworth, KS.

[15] Clairice Veit, *Effects of Apache Helicopter Crew and Unit Training on Combat Mission Effectiveness* (Santa Monica, CA: RAND Corporation, 1989), 1-3.

[16] US Army, FM 25-100, *Training the Force* (Washington: Department of the Army, 1988), 1-4.

[17] The TADS Selected Task Trainer (TSTT) is a training device fielded in every active and reserve component AH-64 battalion. The TSTT is a UNIX computer-based mockup of the front crew station in the AH-64A, and includes the grip surfaces, switches, and TADS found in the front crew station of the *Apache*. It is a training aid for the copilot-gunner (CPG), focused on sustaining and training proper engagement techniques, switchology, and target acquisition. The TSTT is approximately three feet wide, two feet deep, and three feet high. The CPG sits behind the device in a standard desk chair, and the instructor/evaluator sits to the side of the CPG behind a computer monitor and keyboard.

[18]Target Location Error (TLE) is a criteria used during targeting. TLE refers to the maximum error that may be present in locating a target and still expect a successful attack by a certain attack system. For example, an artillery battalion presents a large target, spread over large area. A targeting cell may have a grid coordinate for the battalion, but they assessed the error to be at least two to three kilometers. This error would prohibit the firing of artillery at the target because of the number of round required to both service the target and overcome the error of the targeting. However, an attack helicopter unit could attack the target because they have the ability to search an area, acquire the target, and place direct fires on that target.

[19] FM 1-140 (1996), B-1

[20] Most Army multi-purpose range complexes (MPRCs) are built on plots of land approximately 1000 meters wide and 4500 meters long. While these dimensions are suitable for tank gunnery in which the longest engagement is approximately 2000 meters, this range arrangement can hamper conducting realistic helicopter gunnery training.

[21]Masking terrain is terrain that allows the helicopter to hide, or mask out of the target's line of sight. The act of unmasking is moving, either vertically or horizontally from the mask position to gain line of sight with the target.

[22] The AH-64 CMS G-COFT has enhanced visual weapons firing indications, scoring on gunnery engagement time and target effect (IAW FM 1-140), scoring on degraded modes and situational awareness (i.e., backscatter, drift null, cue updates), scoring on range safety, weapons vs. weather effects and proper deployment, switchology, weapon platform stability, ballistics, IOS pages that will be unclassified, target LOS tracking (IHADSS and TADS), and tactical operations to include ASE deployment. G-COFT has 16 automated exercises (each exercise has ten engagements whose complexity varies by the scoring areas selected). Exercise One scores the *Apache* CPG on how correctly and quickly he is able to complete all of his front seat tasks (IAW -10) from when generators are turned on to completion of weapon initialization (IAW ATM). Exercises 2-16 are based on the gunnery tables in FM 1-140. These exercises will become the standard CMS gunnery exercises for tables 3, 4, 5 for the all Army aviation units. G-COFT has a PC computer with laser printer in the highbay, connected to the CMS computer room. G-COFT exercises and all scoring areas results will be downloaded into the PC from the CMS. This provides exercise performance scores on the individual crew and unit in a report format for the commander and unit trainer. Individuals PCSing will carry a copy of their training level to the next unit. United States Army Aviation Center, "Army Aviation Warfighting Bulletin, 2d Quarter, CY 97", available from http://www-rucker.army.mil/apg/warbull/2ndqtr97.HTM; Internet; accessed 6 May 1997

[23] FM 1-140 (1996), 2-12

[24] With the concurrence of the commander, crew members may validate on Table VII if: (1) The crew members occupy the same crew station as the previous gunnery in which he/she qualified, unless dual-seat designated by the commander, (2) The crew qualified Table VIII during the preceding 12 months on an objectively scored qualification range. (3) Crew is Q1 on validation table. Ibid

[25] Ron Manning, USAAVNC, to author, 20 March 1997, Electronic mail; original in possession of author.

[26] Fort Rucker, Alabama located directly between Ozark and Enterprise, Alabama is located approximately 30 miles north of Dothan, Alabama, and 70 miles south of Montgomery, Alabama.

[27] United States Army Aviation Center, "Directorate of Training, Doctrine, and Simulation homepage"; available from http:// www-rucker.army.mil/dotds/ DOTDSHP.HTM; Internet; accessed 8 April 1997.

[28] The DOTDS division missions shown were downloaded directly from the USAAVNC Internet homepage (Ibid.).

[29] Ibid.

[30] A system training device is one that belongs to a specific system. For example, an AH-64 CMS is a system training device because it was built specifically to resemble an AH-64 and train AH-64-specific tasks. A non-system training device is system non-specific and is built to work with a number of systems. For example, the Army's current gunnery scoring system is a non-system training device because it will score AH-64, AH-1, and OH-58D(I) gunnery, as well as utility helicopter door gunnery.

[31] United States Army Aviation Center, "Gunnery and Aviation Systems Division homepage"; available from http://155.147.98.10/dotds/GASD.HTM; Internet; accessed 8 April 1997.

[32] Ibid.

[33] James Teague, USAAVNC, Telephone interview by author, 10 February 1997, Fort Leavenworth, KS.

[34]Fort Knox is located near Elizabethtown, Kentucky, south-southwest of Louisville.

[35] Armor Master Gunners are noncommissioned officers who attend an intensive 11-week course of instruction at Fort Knox, Kentucky. Training includes advanced gunnery techniques, training program administration, and tank turret maintenance procedures. The closest counterpart to the Master Gunner in Aviation Branch is the instructor pilot.

[36] Tank Crew Evaluator (TCE) is the evaluator assigned to score the gunnery tables during tank gunnery.

[37] CPT Tom Cook, USAARMC, to author, 21 January 1997, Electronic mail; original in possession of author.

[38] The Army National Guard now conducts the AH-1 aircraft qualification course at the Western Army Aviation Training Site (WAATS), Marana, Arizona.

[39] According to a briefing delivered at the Aviation Senior Leader's Conference, 13-17 January 1997 at Fort Rucker, the average attrition rate for aviation warrant officers was approximately 5 percent. However, AH-64 warrant officer attrition rate was 6.6 percent.

[40] According to TSM Longbow, Fort Rucker, the first unit equipped (FUE) with AH-64D *Longbow* helicopters will be 1st Battalion, 227th Aviation Regiment, 1st Cavalry Division, Fort Hood, Texas.

[41] Until recently, manuals were assembled manually, with the graphics pasted on layout sheets. This required that a hard-copy graphic be produced and the text be manipulated to allow the graphic to be placed on the page. Manuals are produced on computers now, with the layout flexible enough to allow the resizing of both graphics and text by the editor. However, the graphics still must be produced in a form that allows them to be imported into the word processing software.

[42] An Aviation Branch captain speaking on the condition of anonymity, Telephone interview by author, 14 February 1997, Fort Leavenworth, KS.

[43] US Army Total Personnel Command (PERSCOM), Alexandria, Virginia is the central proponent for active duty personnel assignment and management for the Army. Each Army branch (i.e. Aviation, Armor, Infantry, Field Artillery, etc.) has a staff at PERSCOM of assignments officers who assign officers to vacancies throughout the Army.

[44] The helicopter gunnery range diagramed in TC 25-8 is not suitable for the current helicopter gunnery training strategy. It is shown as a large impact area with helicopter firing points arrayed along the northern edge. It appears that the intent is for the helicopters to line up along the edge of the impact area and fire their weapons, with no thought given to scoring or maneuver. US Army, TC 25-8, *Training Ranges* (Washington: Department of the Army, 1992), 4-1

[45] FM 1-140 (1996), 3-17

[46] The AH-64A is equipped with a SAL Hellfire training missile. The training missile is an actual Hellfire without a warhead or launch motor. The missiles seeker operates like a live missile's, and gives the crew the indications that a live missile is mounted onboard the aircraft. The missile's seeker will track the *Apache's* coded laser, and allow the crew to practice actual engagements. This capability, coupled with the *Apache's* video recorder, allows the unit instructors to review practice engagements and crew communication.

[47] The special video cassette players required for AH-64A video tapes have a reputation for being unreliable. However, this may have more to do with the field conditions that these devices are normally used in. These recorders are not available through retail dealers.

[48] Dan Bolling, ATSC, Telephone interview by author, 13 February 1997, Fort Leavenworth, KS.

[49] RC units do not conduct advanced table gunnery during peacetime. These tables will be conducted during mobilization training in the event of war.

[50] US Army, TC 1-210, *Commander's Guide to the Aircrew Training Program* (Washington: Department of the Army, 1995), Chapter 6.

[51] There are ten CMS devices: two at Fort Rucker, AL; one at Illesheim, Germany; one at Hanau, Germany; one at Fort Bragg, NC; one at Fort Campbell, KY; one at Camp Humphries, Korea; one at WAATS, Marana, AZ; and two at Fort Hood, TX.

[52] Dan Bolling, ATSC, Telephone interview by author, 13 February 1997, Fort Leavenworth, KS, and LTC Gary Carney, ODCSOPS, Telephone interview by author, 19 March 1997, Fort Leavenworth, KS.

[53] The suspension of rockets was a cease use order by Department of the Army. Rockets that were already on-hand and stored on installations were shipped to Army depots, and could not be issued for firing. Additionally, production of new rockets was halted.

[54] US Army Training Support Center, *Standards in Weapons Training Commission (STRAC) DRAFT Aviation Evaluation Findings* (Fort Eustis, VA: US Army Training Support Center, 1995), 18.

[55] TC 1-210 (1995), 6-6.

[56] CW5 Bobby McNeal, National Training Center, Telephone interview by author, 19 February 1997, Fort Leavenworth, KS.

[57] According to Armor Branch gunnery manuals, tank crews have points deducted from their gunnery scores if they do not use the proper crew coordination. This coordination, referred to as "fire commands", uses standard phraseology to prepare for and execute engagements.

CHAPTER 5

ANALYSIS OF

AH-64A *APACHE* VERSUS AH-64D *LONGBOW*

The United States Army Training and Doctrine Command (TRADOC) has the responsibility for developing future doctrine, as well as training programs. This responsibility includes integration of new weapons systems such as the AH-64D *Longbow*. This chapter will compare the capabilities of the AH-64D and AH-64A; analyze the training aids, devices, simulators, and simulations (TADSS) available for both; and analyze the doctrine and TTP available for *Longbow*-equipped units, as well as doctrinal and training literature available in the future to units fielded with advanced weapons systems.

Comparison of the of AH-64A *Apache* and AH-64D *Longbow*

As discussed in chapter 2, the *Apache* and *Longbow* are similar aircraft but have some major technological differences. The heart of the *Longbow* is the *Longbow* suite. This suite is a collection of hardware that is the defining characteristic of the *Longbow*. This suite includes: a mast-mounted millimeter waver fire control radar (FCR), a Radar Frequency Interferometer (RFI); the *Longbow* Hellfire modular missile system with Radio Frequency seeker; *Longbow* Hellfire launcher; and associated hardware interfaces into the *Longbow* airframe.[1] All of the Army's 811 AH-64A *Apache* attack helicopters will be converted into *Longbows*, although only 227 will receive the fire control radar initially. This means that 558 of the 881 converted *Apaches* will not

be permanently equipped with the fire control radar, but have the wiring and hardware required for upgrading. There is a requirement for the AH-64D Without Radar to be able to convert to an AH-64D With Radar, with the installation of the *Longbow* FCR system and T700-GE-701C engines.[2] Current fielding plans dictate fielding *Longbow* attack battalions with a mix of *Longbow*s with and without radar. The *Longbow* attack helicopter battalion will consist of three attack helicopter companies. The attack helicopter company will have eight aircraft assigned, with a mixture of three AH-64Ds with radar and five AH-64Ds without radar within the company.[3] The current attack helicopter battalion has 24 AH-64A *Apache*s, all equipped with like equipment. The *Longbow* battalion will have nine *Longbow*s with radar, and 15 *Longbow*s without radar, with each type using different engines.

The remainder of this section will compare the capabilities of the AH-64A and AH-64D in the areas of target acquisition, armament, communications, and crew situational awareness.

Target Acquisition. Target acquisition refers to the crew task of searching for, finding, and tracking the target to be engaged. In both the AH-64A and D, the CPG has an identical target acquisition and designation system (TADS). The TADS is mounted on the extreme front of the aircraft and contains three different sensors: forward looking infrared (FLIR), day television (DTV), and direct view optics (DVO). FLIR provides the CPG with the capability of viewing thermal images, both actual size and magnified. It provides four fields of view with magnification up to thirty-four times actual size (34x). DTV provides the CPG with the capability of viewing magnified images during the day and low light conditions. There are three DTV fields of view, providing up to 122x magnification. DVO provides a direct optical link to the TADS (much like a *Cobra*'s sight), and provides the CPG the capability to view real-world objects during daylight. DVO provides a full-color view with up to 17.8x magnification.[4] The TADS is also used by the CPG for navigation and night vision.

The *Longbow* is equipped with additional target acquisition equipment to assist the crew. This includes the fire control radar (FCR) and the radar frequency interferometer (RFI).

Fire Control Radar. The FCR is mounted in a fairing above the *Longbow*'s rotor system. This mounting scheme gives the *Longbow* a unique appearance when compared to the A-model *Apache* as shown in Figures 1 and 2.

Fig 1. AH-64A *Apache*. Source: McDonnell Douglas Corporation; available from http://www.mdc.com/version2/photos/photmhl.htm; Internet; accessed 8 April 1997.

Fig 2. AH-64D *Longbow*. Source: McDonnell Douglas Corporation; available from http://www.mdc.com/version2/photos/photmhl.htm; Internet; accessed 8 April 1997.

The other components of the suite are mounted inside the helicopter's fuselage. The FCR enables *Longbow* suite-equipped helicopters to detect, classify (i.e. tracked, wheeled, air defense, hovering, flying), prioritize, and engage targets with radar frequency (RF) *Hellfire* missiles without visually acquiring the target.[5] Unlike the AH-64A, the *Longbow* crew does not have to establish visual line-of-sight with the target prior to engagement. This allows employment during periods of poor visibility when laser, optical, and FLIR systems are degraded. The FCR will not identify targets as either friend or foe.[6] The FCR has the capability of acquiring ground targets at 8 kilometers in all types of terrain. The FCR cannot acquire two-dimensional plywood range targets. In radar map mode, the FCR will show dead space not covered. Because the range of the missile is greater than the FCR, crews may use TADS designation at long ranges to hit targets with RF Hellfire missiles.[7]

Radar Frequency Interferometer. Enemy radars, particularly those associated with air defense units (ADU), pose a threat to all friendly aircraft. Detection of radar systems is critical to ensure the survival of attack helicopters during the attack. The AH-64A *Apache* has a radar detector known as the AN/APR-39A (V)1. The APR-39A (V)1 is the basic radar warning receiver (RWR) for Army helicopters that warns aircrew members of possible pulse radar threats. The system monitors the radio frequency (RF) environment and provides real-time warning, visual and aural, to the pilot. The system provides warning via a synthetic voice, and a round (approx. 3 inches across) flat screen display on the instrument panel that can display symbols representing up to seven radar threats. When the pilot receives a warning he can employ tactical measures to protect the aircraft before receiving fire from radar directed threats.[8] The base *Apache* has no targeting capability with the APR-39. The pilot must make targeting decisions based on the indications of the units display.

Longbow has dramatic improvements in range and angular accuracy of location and identification of ground and airborne radars as a result of AN/APR-48A Radar Frequency

Interferometer (RFI). Even though it is equipped with the AN/APR 39 A(V1), the *Longbow* has the RFI, which is a passive all-weather radar detection system made by Lockheed Martin. The RFI is designed to minimize target acquisition and platform exposure times. The system is mounted above the AH-64D helicopter rotor blades and the makers claim it provides a reduction in pilot targeting workload by 80 percent. They also claim, as a result of enhanced situational awareness and targeting capabilities that the RFI helps to eliminate fratricide.[9] Actually, the *Longbow* system will display an ADU target symbol when a detected threat radar emitter is on the approximate azimuth as an FCR target. This is referred to as target merging. Once a threat is merged, it may be engaged with RF *Hellfire* missiles, rockets, or cannon.[10]

Armament. Both the *Apache* and *Longbow* are equipped with a 30 mm Chain Gun cannon, Hydra 70 Folding Fin Aerial Rockets, and semi-active laser (SAL) Hellfire missiles. The employment considerations of these weapons is very similar between the two aircraft. While both the cannon and rockets can be fired either with direct or indirect fire, the SAL requires laser energy for guidance of the missile. This requires the aircraft maintain line-of-sight with the target, with the CPG physically aiming the laser (through the TADS) at the intended point of impact.

Even though it has all of the capabilities of the base *Apache*, the *Longbow* adds a unique weapons capability. The Radio Frequency (RF) Hellfire has a true "fire and forget" capability. Once a target is acquired with the FCR, the targeting data is automatically passed to an RF Hellfire missile mounted on one of the *Longbow*'s weapon pylons. Once the CPG fires the missile, no further guidance from the crew is required to complete the engagement of the target. In addition, the FCR and TADS are integrated in the *Longbow*. When the crew desires to visually acquire or identify an FCR priority target, the TADS may be linked to the FCR. This function will physically move the TADS to any FCR detected target desired. When desired, the FCR may be prepointed to a TADS acquired target when the TADS line of sight reticle is on the desired target.[11]

Even in *Longbow*'s without radar, the RF missile may still be employed. The *Longbow* system can pass targeting between helicopters via digital communications, or it can use data taken from the TADS. For example, crews may employ the TADS to provide the necessary target information through the system to RF missile seekers. Although the acquisition times of the system will be longer, this capability will even allow a *Longbow* with Radar with radar malfunctions to continue the mission. The engagement may be conducted by lasing a target with the TADS until targeting data is handed over to the missile. When the missile is ready to fire, the CPG launches the missile without a requirement to continue tracking until impact. RF missile performance is not compromised using this technique.[12]

Communications. Both the *Apache* and *Longbow* are equipped with a number of voice communications radios. Each are equipped with two Single Channel Ground/Airborne Radio System (SINCGARS) FM radios, one VHF voice radio, and one UHF (HAVEQUICK) voice radio. In addition to voice communications, the *Longbow* is equipped with the a digital communications device, the Improved Data Modem (IDM). The IDM is a tri-service compatible digital messageing device that can send spot reports, situations reports, battle damage reports, target handovers, and free text messages digitally between aircraft and ground stations over existing radio nets.[13]

The implications of the IDM are numerous. Likely the most significant is the ability to process and pass targeting information between *Longbow*s. For example, a commander in a *Longbow* with FCR can digitally send targeting information to the other aircraft in his company. This process is much more reliable and quicker than having the commander recite the locations of targets while CPGs in other aircraft transcribe the data. Also, changes of missions can be sent digitally to each crewmember, reducing the possibility of errors during transcription of instructions. The only drawback to all communications on both the *Apache* and *Longbow* is a

physical one: all installed radios are line-of-sight. A nearly straight, unobstructed line must exist between the transmitter and receiver; any barriers in that line will likely disrupt the radio communication. This is significant because the geography of a particular theater may interfere with communications, both voice and digital, between aircraft and ground stations.[14] The future introduction of non-line-of-sight (NLOS) radios will enhance the digital capability further.

Situational Awareness. Another major difference between the *Apache* and *Longbow* is crew situational awareness. Situational awareness is the real-time accurate knowledge of one's own location and orientation, as well as the locations of friendly forces, enemy forces, and noncombatants.[15] The *Apache* crew establishes its situational awareness much like the first armed-helicopter crews did in Algeria: visually using a map and compass, and communicating on a voice-only radio. Even though *Apaches* are receiving precision navigation systems such as the Global Positioning System (GPS), the *Apache* crew will likely experience difficulty visualizing where it is located in relation to the other aircraft in the flight. When this occurs, determining where the enemy and other friendly elements are in relation to the attack helicopters becomes very difficult.

With the capability afforded by the *Longbow*'s FCR and digital communications, the commander can keep precise track of where his aircraft are located in relation to his aircraft. For example, the commander is positioned in a hovering battle position just behind his company's aircraft. The crew can use the FCR to physically locate other aircraft in the area. The preferred method, however, is using the IDM. The IDM contains a feature that allows a digital query of a preregistered number of aircraft. For example, by pressing Present Position Query, the IDM will query the aircraft in the flight, update position with GPS, and show icons on the aircraft's Tactical Situation Display (TSD) on the instrument panel. Icons representing his aircraft are displayed on his cockpit display. Once the processing is complete, the commander can digitally send the data to all of his helicopters, updating their information. This enhancement proved very effective in

reducing cockpit workload and stress, particularly for the commander, during the Initial Operational Test and Evaluation of the *Longbow*.[16]

In summary, the AH-64D *Longbow* retains the best capabilities of the AH-64A *Apache*, while adding significant new warfighting capabilities. These include enhanced target acquisition, armament, communications, and crew situational awareness.

Training Aids, Devices, Simulators, and Simulations

Aircraft-specific Training Aids, Devices, Simulators, and Simulations (TADSS) assist in the training of aviators not only at USAAVNC, but also in units. This section will discuss training aids intended for use by crewmembers, and the differences in *Apache* and *Longbow* TADSS strategy.

AH-64A *Apache*. There are three simulators used in training and sustaining *Apache* crewmember skills; the Combat Mission Simulator (CMS), the TADS Selected Task Trainer (TSTT), and the Cockpit Weapons Emergency Procedure Trainer (CWEPT).

CMS. The U.S. Army's AH-64 *Apache* Combat Mission Simulator (CMS) is the most advanced vertical lift attack helicopter simulator in the world. AH-64 Link Trainer CMS flight simulators are fielded in the United States, Europe, Egypt and Korea. Under a contract received in late 1995, Hughes Training, Inc., is upgrading 10 AH-64 combat mission simulators with a Gunnery Conduct of Fire Training capability. By providing this capability, the Army will substantially reduce operational costs associated with firing actual live *Hellfire* missiles, Hydra rockets and 30 mm rounds over training ranges, further enhancing and maintaining aircrew weapons systems proficiency and qualification.[17]

The CMS is a proven crew-proficiency trainer. A 1989 RAND study states that "...CMS training is a very valuable tool for mission training. Two advantages to CMS training over

training in the field is that pilots can really shoot at and laser designate targets."[18] The CMS has been proven so effective that Army regulations allows *Apache* crewmembers to apply up to 24 hours of CMS training time to their annual 140 hour requirement of flight hours in the *Apache*. In short, up to 17 percent of the crewmembers flight time annually can be accomplished in the CMS.

The CMS is a large device. It requires a big building to house. This is the tradeoff required for fidelity in the CMS. Each CMS cockpit has approximately 45 inches of travel; this amount of travel is required to produce six degrees of freedom (DOF). Six DOF is required to produce realistic cueing in simulators. The National Aeronautics and Space Administration (NASA)-Ames Research Center recently completed a study saying that simulators require at least 6 degrees of freedom (DOF) to adequately train low airspeed, low altitude flight inherent in helicopter operations. This motion is important for allowing skill mastery of helicopter tactics.[19]

Though CMSs are resource-intensive, the training provided is proven and worthy of replacing actual *Apache* flight hours. Additionally, a staff study in progress at USAAVNC to determine the utility of completing Tables I and II in the CMS. There is a proposal for the AH-64A AQC gunnery training to be reduced to one live-fire familiarization gunnery period.

TSTT. As mentioned in the previous chapter, the TSTT is a specialized trainer used for the CPG in the front seat crew station. Every AH-64 battalion has at least one TSTT assigned, and FM 1-140 mandates its use for helicopter gunnery training during Table V. 21st Cavalry Brigade, Fort Hood, uses networked TSTTs for collective gunnery training. This training is primarily focused on fire distribution between CPGs. Interestingly, this is the only *Apache* collective skills trainer/simulator available.

CWEPT. The CWEPT is a cockpit mockup used by instructors to train and sustain basic crew skills. It has the same dimensions as an actual *Apache* cockpit. It has the same instruments and basic cockpit layout as the *Apache*; it is approximately seven feet tall, and is approximately

the same length as the actual crew stations. The CWEPT is mounted on casters, and unlike the actual *Apache*, has no Plexiglas installed around the crew station.

In 1986, there was a plan to adopt the CWEPT as the *Apache* sustainment trainer. Each *Apache* battalion was scheduled to receive one. USAAVNC accepted the CWEPT as a lower-fidelity partial task trainer, not a sustainment trainer. USAAVNC believed that the fidelity of the CWEPT was too low, and it reduced the number of tasks capable of being trained in the CWEPT from 151 to 28.

The Apache Crew Trainer (ACT) is an upgraded CWEPT. Like the CWEPT, it does not have a motion capability, but it does have an out-the-cockpit computer generated visual system added. ACT was envisioned as a low-cost replacement to the CMS.[20] While the manufacturer stated 151 tasks could be trained using the ACT, USAAVNC accepted it as a 28 task trainer only. In this regard, it is very similar to the CWEPT, only more costly. Only one CWEPT was converted to the ACT configuration, and no more will be produced. McDonnell-Douglas, the manufacturer of the *Apache* and *Longbow*, is also the manufacturer of the CWEPT and ACT.

AH-64D *Longbow*. The *Longbow* will have one simulator: the Longbow Crew Trainer (LCT). The LCT is basically a *Longbow* ACT. Seven LCTs will replace all ten CMSs, four CWEPTs, and at least twenty-four TSTTs. The LCT, unlike the ACT will have a dynamic seat with approximately 6/10" motion, or less than 4 degrees of freedom (DOF). The first three LCTs will be delivered in October 1999 (2-Fort Rucker, 1-Fort Hood). This is also the month *Longbow* AQC begins at USAAVNC. According to TSM-Longbow at USAAVNC, the LCT is planned to be used similar to the CMS in flight hours. Additionally, gunnery training will be an important feature of the LCT.[21] McDonnell-Douglas, builders of the CWEPT and ACT, has been selected by PM Longbow to build the LCT.

The British Army, who is buying the *Longbow*, see the LCT as complementing the full-motion simulator, not a replacement as the US does.[22] There is currently some controversy at USAAVNC as to whether the fidelity of the LCT will replace the fidelity of the CMS. In particular, will *Longbow* aviators be able to use the LCT for up to 17% of their minimum flight time? Will the 4 DOF present in the LCT suffice in simulating helicopter flight? An interesting implication of the DOF debate is that Federal Aviation Administration (FAA) regulations require that for a device to be considered a flight simulator, it must have at least 6 DOF. Unlike the current *Apache* CMS, there is a possibility that if the LCT has only 4 DOF, flight time accrued and evaluations completed in the LCT may not be valid for FAA qualifications.[23] Despite these concerns, *Longbow* units are going to receive the LCT to replace the *Apache* CMS. According to TSM-Longbow at USAAVNC,

> Reality is that we are going to get non-motion based simulators that will have a dynamic motion seat to provide motion cueing and that will be all for individual and crew qualification and sustainment training unless the Aviation leadership and DA change the strategy and the program to go Full Motion. We may have to accept the non-motion base simulator to replace aircraft hours as we do now in the CMS because the future flying hour program is not going to increase because we call the LCT a Part Task Trainer.[24]

Future Doctrine and Training Literature

This section is an overview of the Army and USAAVNC attempt to field doctrine and training programs for the *Longbow*. First, it is appropriate to define what doctrine is and how it relates to tactics, techniques, and procedures.[25]

Doctrine. Doctrine is the body of fundamental principles by which military forces guide their actions in support of national objectives. It is authoritative but requires judgement in application. Doctrine provides the fighting philosophy of the Army, a common language, and structure within which units plan and conduct combat operations.

Tactics. Tactics describe how the leader carries out doctrine. Tactics has two basic meanings, both relating to the arrangement of forces for battle: the employment of units in combat, and the ordered arrangement and maneuver of units in relation to each other and to the enemy in order to utilize their full potential. Tactics, like doctrine, are applied with judgement by the leader.

Techniques. Techniques are the methods of performing any act, especially the detailed methods used by troops or commanders in performing assigned tasks. Techniques are the basic methods of using equipment and personnel.

Procedures. Procedures are the lower level of detail. The address how-to at the task level. Procedures include SOPs, weapon and equipment operating steps, crew drills, and staff drills. Procedures are building blocks of individual and collective task accomplishment that serve as the foundation of tactics and techniques.

In summary, doctrine and TTP define common references for all levels from the individual at the tactical level to the operational and strategic levels. Thus, doctrine and TTP is critical to ensure that all individuals and units are on a common plane when it comes to employment in combat.

Longbow units can expect to participate in the range of military operations described by the 1993 version of FM 100-5, *Operations*. Specifically, *Longbows* will be used during *peace*, *conflict*, and *war*; these three environments can be referred to as *war* and *military operations other than war* (MOOTW). On the surface, war and MOOTW employment of the *Longbow* will be no different than the employment of *Cobras* in Vietnam, Haiti, and Somalia, or the use of *Apaches* in the Gulf War, Panama, or Bosnia. MOOTW is a particularly big, complex mission. While generally referred to as a single mission in periodicals and discussions, MOOTW actually contains fourteen separate missions. FM 100-5 lists noncombatant evacuation operations (NEO), arms control, support to domestic civil authorities, humanitarian assistance and disaster relief, security

assistance, nation assistance, support to counterdrug operations, combating terrorism, peacekeeping operations, peace enforcement, show of force, support for insurgencies and counterinsurgencies, and attack and raids as MOOTW operations. It also states that each of these missions require force.[26]

Even during the height of the Cold War, the 1986 version of FM 100-5 also referred to operations short of war. In this version of the manual, these operations were referred to as contingency operations. Contingency operations are military actions requiring rapid deployment to perform military tasks in support of national policy. Such operations are normally undertaken when vital national interests are at stake and direct or indirect diplomacy and other forms of influence have been exhausted or need to be supplemented by either a show of force or direct military action.[27]

To summarize, the doctrine writers that produced the last two versions of FM 100-5 clearly saw the Army conducting operations short of full-scale war. While it is true that the 1993 version coined the term OOTW, the 1986 version devoted a chapter to the discussion. The current doctrinal manual for the employment of AH-64A, AH-1F, and OH-58D(I) aircraft and units is FM 1-112, *Attack Helicopter Battalion*, dated February 1991. USAAVNC has recently completed a final draft of a new FM 1-112, dated December 1996, and renamed as *Attack Helicopter Operations*. Unfortunately, the current attack helicopter doctrinal manual devotes only five pages to OOTW, of which two pages are a reprint of the descriptions of the OOTW operations from FM 100-5. While the remainder of the pages contain some interesting lessons learned, there are no planning or employment guidelines available to the commander. This is in contrast to the manual's chapter 3 which contains 17 pages on how to build an engagement area and distribute fires against a massed enemy armor or mechanized force.

There may be several reasons for this. First, the 1991 version of FM 1-112 was approved the week the ground offensive started in the Gulf War; its principles were clearly aligned with the anti-armor mission assigned *Apaches* in the impending Operation DESERT STORM. Because the current FM 100-5 at that time had limited emphasis on "contingency operations", the manual was clearly focused on the massed armor threat of the Soviet Union. The 1996 version of FM 1-112 was written primarily during the period that FM 100-5 was being introduced in 1993 and 1994. Lessons learned for attack helicopters in OOTW were not incorporated in the drafts, and the focus of the manual was still on attack operations against massed armor. There may have been a reluctance to place too much emphasis on using *Apaches* in OOTW operations because, until the Bosnia operation in 1995 and 1996, the *Apache* had never been used in an OOTW mission.

Therefore, the 1991 and 1996 versions of FM 1-112 serve as the baseline for *Longbow* employment doctrine. USAAVNC has published ST 1-EX4, *Tactics, Techniques, and Procedures for the Digitized Aviation Task Force* as a supplement to the current aviation doctrinal manuals, to include FM 1-112.[28] This ST is not a doctrinal manual, but it contains a great deal of technical information on the Army's new information systems. It also contains technical information, as well as TTP for the *Longbow* similar to the *Apache* TTP in FM 1-112; specifically, how to fly in formation, who should lead the flight, what to do in the battle position, etc. In spite of these documents, *Longbow* aviators and leaders do not have a definitive reference on how to employ their aircraft in the range of military operations other than war. Interestingly, neither do *Apache*, *Cobra*, or *Kiowa Warrior* aviators or leaders.

Challenges. There are several challenges that will have an impact on the *Longbow* crew and unit. These include information management, employment doctrine, and engagement of a wide range of targets without collateral damage.

Information management. The *Longbow* crew will likely have to manage a great deal more information in the cockpit than the *Apache* crew, even though the crewmember's ability to remember, recognize, and analyze data has remained constant. Currently, the *Apache* has "voice only" capability. The techniques used to manage up to four radio nets has not changed a great deal over the last twenty years. It becomes difficult to determine from which radio the transmission is coming from. To address this, based on experience, the crewmembers can divide the duties between nets to lessen workload. Another technique is for the individual crewmembers can adjust the volume on each radio so that volume of transmissions is distinct, further helping to identify the radio and net. Crewmembers in companies and battalions that routinely train over a period of time can identify the voice of the individual making the radio call almost immediately, helping to identify both the caller and the net. *Longbow* crewmembers will have to use techniques such as these, as well as techniques for sending and receiving digital data. The digital communications nets require precise procedures and strict net discipline. While it is desirable to allocate separate nets for voice and digital information, the nets may still become congested, corrupting digital data transmission. Commanders may have to implement "digital traffic control plans" which establish transmission times for various types of data.[29] It is also expected that the use of line-of-sight radios for digital data transmission will likely hamper the free flow of information between *Longbows*, as well as ground stations depending on the prevailing terrain. Geographical, as well as man-made features such as buildings are known to hamper these communications.

Poor communications between aircraft and ground stations cause confusion and stress in the cockpit. Because of this and the unavoidable malfunctions that will occur with digital systems, ST 1-EX4 recommends that *Longbow* crews be prepared to operate their helicopter without reliance on digital communication equipment to ensure mission accomplishment.[30]

Employment Doctrine. It is likely that the first *Longbow* battalions will be fielded without *Longbow*-specific employment doctrine available from USAAVNC. While the initial USAAVNC effort toward *Longbow* doctrine is admirable, the new FM 1-112 is being published without *Longbow*-specific TTP. Conversations with USAAVNC indicate that there very few personnel dedicated to writing and updating *Longbow* doctrine; however, this is not am unprecedented problem. When the AH-64A was fielded, specific employment doctrine did not immediately appear for transitioning units; actually, specific TTP for the *Apache* was not published by USAAVNC until 1996, over 10 years after the first *Apache* units were fielded at Fort Hood, Texas. The *Apache* was fielded with modified *Cobra* doctrine which did not exploit the advanced capabilities present in the AH-64A.

An example of this "doctrine modification" approach was present during the 1st Battalion, 1st Aviation Regiment, 1st Infantry Division (Mech) transition from *Cobras* to *Apaches*. The unit deployed from Fort Riley, Kansas to Fort Hood, Texas in September of 1989 for the Unit Training Program (UTP) at the *Apache* Training Brigade. 1-1 Aviation was the sixteenth transitioning unit to participate in the UTP. During the fall of 1989, the unit was issued its eighteen *Apaches*, and individual training was conducted. When the unit began training for unit evaluations in December of 1989, the doctrinal manual used as the reference was the July 1986 version of FM 1-112, *Attack Helicopter Battalion*. This manual presents the same TTP for *Cobra* and *Apache*-equipped battalions. While there are a few pages dedicated to *Apache* employment, all graphics show the *Apache* unit equipped with the OH-58D. As mentioned earlier, the OH-58D is a sophisticated scout aircraft equipped with digital communications and a designation laser; in addition, the OH-58D was never fielded to the *Apache* battalion. The scout helicopter in the *Apache* battalion was the OH-58C, a Vietnam-era scout used in *Cobra* battalions. Also, the FM 1-112 graphics show

both the *Apaches* and OH-58Ds equipped with high-frequency radios, a device that has yet to be fielded.

When unit training began for 1-1 Aviation, the trainers at the Apache Training Brigade recommended that the companies be organized per FM 1-112; three scouts and five *Apaches*, also known as a 3/5 mix. The 3/5 mix would be broken into a heavy team (one scout, three *Apaches*) and a light team (one scout, two *Apaches*), with the commander in a scout.[31] In addition, the trainers recommended that for tactical movement, the order of "march" should be light team, commander, and then the heavy team. These movements should have OH-58C aircraft in the lead, as depicted in FM 1-112. While this arrangement worked well with *Cobra* units, there were some distinct problems when applied to *Apache* units. First, the *Apache* crew had the capability to acquire and designate targets at ranges in excess of six kilometers. The scout crew, particularly at night, were likely to be able to see less than one kilometer with night vision goggles. Second, the *Apache* has a sophisticated, computer-controlled navigation system, allowing the crew to navigate over difficult terrain accurately with few inputs. The OH-58C crew used paper maps and a compass to navigate. Finally, the *Apache* crew can use a laser range finder to accurately determine an eight-digit grid coordinate for targets. The OH-58C crew must use a map to determine its own position, interpret terrain or estimate the range to target, and be able to pass that grid an engaging *Apache* crew. This is extremely difficult in any terrain, particularly at night. These challenges make it difficult to accomplish the mission of the scout: see the battlefield, find the enemy, and coordinate the destruction of the enemy with attack helicopters.[32] While adequate for the AH-1 *Cobra*, the OH-58C was completely inadequate for the advanced capabilities of the *Apache*; however, ATB was incorporating the *Apache* into the 3/5 mix like it was a *Cobra*.

The battalion commander of 1-1 Aviation modified this doctrine for the new unit. First, the companies were organized into three teams. These teams consisted of two *Apaches* and one

OH-58C. Second, the OH-58C followed the *Apaches* on the route to the objective, and provided security in the battle position rather than trying to acquire and track targets. Third, the company commander flew in an *Apache*. This was critical to see the battlefield, as well as having the situational awareness provided by the *Apache*'s navigation and optics systems. Additionally, 1-1 Aviation did not take OH-58C helicopters on deep attack missions such as raids; their inferior navigation abilities, slow speed, and vulnerability to ground fire keep the OH-58C focused on close operations.[33]

Like the employment doctrine, gunnery doctrine was also a holdover from *Cobras*. The range and target arrays used by ATB were also used by *Cobra* units at Fort Hood. In addition, there was an initiative at Fort Rucker to allow *Apache* units qualify in the CMS, rather than conducting live fire gunnery qualification.[34]

In summary, there are some interesting parallels between employment and gunnery doctrine; specifically, advanced weapons were fielded seemingly without adequate analysis applied to how they would or should be used. *Longbow* doctrine may evolve like the *Cobras*; if this is the case, there were no lessons learned from the fielding of the *Apache*.

Target Engagement and Collateral Damage. *Longbow* crews will likely be required to engage targets precisely, with little or no collateral damage. The requirement for "low or no" collateral damage seems to have become a top priority during the US Army's involvement in Somalia in Operation RESTORE HOPE (December 1992 to May 1993) and UNISOM II (May 1993 to March 1994). Based on Center for Army Lessons Learned (CALL) data, precision guided munitions are favored because they are likely to reduce the danger to both civilians and friendly troops.[35] This observation is also noted in a RAND study that noted that cannons, like those mounted on the *Apache* and *Longbow*, are excellent for use in urban terrain or in circumstance where collateral damage should be limited.[36]

While the *Longbow*'s superior target acquisition against massed armor targets is unquestioned, the utility of the FCR in urban environments is unknown. In addition, the technology used by the RF missile may be unusable in an urban setting. In short, the *Longbow* crew may use cannon and SAL Hellfire engagements in OOTW operations to preclude collateral damage. The advanced features of the *Longbow* may not be used to their full potential unless employed against a massed armor threat.

Force XXI Doctrine and Training Literature

This section will be a brief discussion of Force XXI training. As mentioned in Chapter 2, Force XXI is the US Army of the early twenty-first century. The cornerstone of Force XXI doctrine is information dominance, or the ability to exploit information. TRADOC PAM 525-5, *Force XXI Operations*, provides the blueprint for Force XXI. This blueprint states that Force XXI must be prepared to conduct quick, decisive, highly sophisticated operations; while on the other, it must be ready to execute limited, often protracted operations against low-technology enemies. For Army Aviation, information technology will greatly increase the volume, accuracy, and speed of battlefield information available. This capability coupled with what may appear to be ambiguous operations will likely cause changes in the way Aviation is employed. Despite these changes, there appears to be little impact on the methods used to train *Longbow* aviators, as well as the doctrinal manuals produced by USAAVNC.

A possible problem with the *Longbow* and Force XXI is the infatuation with technology associated with a new weapon system. Each month in *Army Aviation Magazine*, attractive color ads appear touting the increased warfighting capability of the *Longbow* over the base *Apache*. Even though the Chief of Staff of the Army has stated that "...[conflicts] during the next five to fifteen years will be in the "non traditional" category or "unconventional combat" under strict rules

of engagement"[37], briefings and articles produced by contractors and USAAVNC continue to show *Longbows* attacking massed armor formations. Because of the low tolerance for collateral damage that will likely be present during the next operation conducted by the Army, the *Longbow*'s most capable weapon against armor, the RF *Hellfire*, may be unusable. What will be indispensable is a well-trained crew that have a high-degree of proficiency employing all of *Longbow*'s weapons and capabilities.

The capabilities of new technology, specifically computers, should not be discounted, but rather put into perspective. Almost daily feats of technological brilliance appear in the media. For example, in December 1996, Intel Corporation announced it had broken the supercomputer speed record with a machine that performed more than 1 trillion calculations per second. This gives scientists a tool to simulate everything from nuclear explosions to an entire strand of human DNA. The machine, which crunches numbers with a technique known as massively parallel computing, was built by connecting thousands of the same kind of Intel Pentium Pro microchips found in standard computers.[38]

Meanwhile, IBM announced it was under government contract to build a computer capable of over three trillion calculations per second. IBM, long a standard-bearer for computer technology, is building this computer to help simulate nuclear explosions for US weapon research. While these computers are extremely powerful, they are unable to make decisions that may appear simple to human beings. This can best be illustrated by chess master's Gary Kasparov's defeat of IBM's Deep Blue computer in a regulation six game chess match in February, 1996. The computer used massively parallel processing to process over 200 million calculations per second. Of the six matches, the computer won one, there were two draws, and Kasparov won two.[39] While it appears that the computer came very close to defeating Kasparov, the computers designer stated, "One reason we lost is that we don't have the chess experience and knowledge that Mr. Kasparov

has."[40] There are some facts regarding chess that must be weighed. First, there are 64 squares on a chess board. Each of the two players has 16 chess pieces that may be moved according to the rules of chess (for example, diagonally or horizontal/vertical). This produces a finite, though extremely large number of positions that the 16 pieces may occupy, even though the regulation chess match is limited to 50 total moves. Second, each player knows precisely where the opposing player's chess pieces are located on the chess board, as well as precisely what moves those pieces may make. There are typically no surprises on the chess board; each players "forces" are in the open. Third, the object of the game is clearly known from the first move; checkmate. Checkmate is the condition where the chess piece known as the "king" is either captured or is unable to move because of imminent capture by the opposing forces.[41] Even though there were these specific rules, the human player was able to defeat an incredibly powerful computer.

The contest between the computer and the human player helps put Force XXI and the *Longbow* into perspective. Human decision making cannot be replaced by computers in the near term. Based on history, it is rare or unheard of for an army to have perfect intelligence on its enemy, know the precise locations, capabilities, and mobility potential of its equipment, and know his specific war aims and objectives prior to the first shot being fired. Because computers are still relatively "dumb" in the sense they only know what they are programmed to know, the key training tenets expressed in FM 25-100 and 25-101 are valid, train as you fight. *Longbow* crews, not computers, will be asked to make the decision whether to engage or not in theaters with restrictive ROEs. *Longbow* crews, not computers, will have to decide whether to engage a target with an RF or SAL Hellfire missile. *Longbow* crews, not computers, will be ultimately responsible for the decisions made in combat. Because of this, the training of crews will likely become more, not less critical as information-age technologies are fielded. The typical *Longbow* crew will have to sort through information streaming into the cockpit over not only voice and digital communications

nets, but from the FCR and RFI as well. And, as stated earlier, these crews are going to be recruited, selected, and trained in roughly the same manner as *Apache* crews are at the present. In short, the human dimension will become increasingly important with the introduction of new technologies, not less.

In conclusion, the following passage on chess strategy is relevant not only to chess, but could also be applied to decision making in combat in the computer age:

> The tree of possible moves branches so rapidly, one can rarely search to mate. Which branch of the tree leads to an advantage? This necessitates the use of search heuristics - or shortcuts which direct our attention to certain aspects of a position while ignoring the rest. The application of these heuristic is what distinguishes between players of different levels. Grandmasters choose not to use their "masterly" analytic abilities so much but rely more on search heuristics. The results are they typically find the best move, and take less time to do it.[42]

Summary

This chapter compared the capabilities of the AH-64D and AH-64A, analyzed the training aids, devices, simulators, and simulations (TADSS) available for both aircraft, analyzed the doctrine and TTP available for *Longbow*-equipped units, as well as doctrinal and training literature available to units fielded with advanced, Force XXI weapons systems. In short, based on the Force XXI requirements, the *Longbow* attack helicopter unit of the near future will have a large number of tasks to perform for mission accomplishment without a significantly new doctrinal base, nor improved TADSS to draw upon. Additionally, the *Longbow* crew will likely not receive additional training on TTP for managing and exploiting the large amounts of information available in the *Longbow* cockpit. The focus on the human dimension of Force XXI training, particularly for the *Longbow*, appears to have received little attention.

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[1] US Army Aviation Center, "Longbow Fact Sheet/Information Paper" (Fort Rucker, AL: TSM Longbow, 21 Jan 93), 1.

[2]The AH-64A has two General Electric (GE) T700-GE-701 engines: one mounted in large fairings on each side of the aircraft. Power from the two engines are combined in a large transmission which drives the *Apache*'s main rotor system and tail rotor system. Longbows with radar require T700-GE-701C engines to be installed. This requirement comes from maintaining the performance of the Longbow without radar, while having to lift the additional weight of the Longbow FCR system.

US Army Aviation Center, ST 1-EX4 version 4, *Tactics, Techniques, and Procedures for the Digitized Aviation Task Force* (Fort Rucker, AL: US Army Aviation Center, 1996), C-15.

[4] US Army Aviation Center, Student Text 15-6438-6, *AH-64A Target Acquisition and Designation System (TADS)* (Fort Rucker, AL: US Army Aviation Center, July 1988), 37.

[5] ST 1-EX4 v.4 (1996), C-4

[6] Ibid.

[7] CW4 Billy Tompkins, *Longbow* Instructor Pilot, Telephone interview by author, 24 February 1997, Fort Leavenworth, KS.

[8] US Army Aviation Center, Student Text 33-1888-3, *Aircraft Survivability Equipment* (Fort Rucker, AL: US Army Aviation Center, March 1990), 11-13.

[9] Lockheed Martin Corporation, "Lockheed Martin homepage"; available from http://www.lmco.com; Internet; accessed 7 February 1997.

[10] ST 1-EX4 v.4 (1996), C-4.

[11] Ibid

[12] Ibid., C-22

[13] Ibid., C-5

[14] Tompkins, 24 February 1997.

[15] FM 1-140 (1996), 6-1.

[16] Tompkins, 24 February 1997.

[17] Hughes Aircraft Company, "AH-64 Combat Mission Simulator homepage"; available from http://www.bgm.link.com/ah-64cms.html; Internet; accessed 8 April 1997.

[18] Clairice Veit, *Effects of Apache Helicopter Crew and Unit Training on Combat Mission Effectiveness* (Santa Monica, CA: RAND Corporation, 1989), 6-7.

[19] John Rivenbark, USAAVNC, Telephone interview by author, 24 February 1997, Fort Leavenworth, KS.

[20] Ibid.

[21] MAJ Morgan Lamb, TSM Longbow, to author, 15 February 1997, Electronic mail; original in possession of author.

[22] Rivenbark, 24 February 1997.

[23] US Department of Transportation, Federal Aviation Administration (FAA) Advisory Circular 120-63, *Helicopter Simulation Qualification* (Washington: Government Printing Office, 11 October 1994), 11.

[24] MAJ Anthony Pelczynski, TSM Longbow, to author, 6 March 1997, Electronic mail; original in possession of author.

[25] These definitions are synthesized from several Army field manuals, particularly FM 17-95. US Army, FM 17-95, *Cavalry Operations* (Washington: Department of the Army, September 1991), B-1.

[26] FM 100-5 (1993),13-4 - 13-8.

[27] FM 100-5 (1986), 12-1.

[28] ST 1-EX4 v.4 (1996), Preface.

[29] Ibid., 1-11.

[30] Ibid., 1-12.

[31] FM 1-112 (1986), 3-4.

[32] Ibid., 3-1.

[33] The author of this thesis served as a staff officer in 1st Battalion, 1st Aviation Regiment during the *Apache* Unit Training Plan (UTP), Fort Hood, Texas from September 1989 through May 1990.

[34] Jim Teague, USAAVNC, Telephone interview by author, 10 March 1997, Fort Leavenworth, KS.

[35] John Hansen, "The Role of the Attack Helicopter in Operations Other Than War." (MMAS Thesis, US Army Command and General Staff College, 1995), 78, citing US Army, *US Army Operations in Support of UNOSOM II* (final draft), (Fort Leavenworth, KS: Center for Army Lessons Learned, October 1994), I-6-2.

[36] Alan Vick et al., *Enhancing Air Power's Contribution Against Light Infantry Targets* (Santa Monica, CA: RAND Corporation, 1996) , 34-36.

[37] GEN Dennis Reimer, "Random Thoughts While Running," Electronic mail message to the US Army staff, Washington, DC, 22 January 1997.

[38] The Associated Press, "Intel breaks speed record: A trillion calculations in 1 second," *Kansas City Star*, 17 December 1996, sec. 1, p. 8.

[39] Christopher McDougall, "Deep Blue, Good-bye," *Kansas City Star*, 18 February 1996, sec. 1, p. 5.

[40] Ibid.

[41] *Microsoft Encarta*, 1997 ed., s.v. "chess" [CD-ROM] (Redmond, WA: Microsoft Corporation, 1997).

[42] Chris Petroff, "Chess Maxims from the Web"; available from http://caissa.onenet.net/chess/texts/Shortcut; Internet; accessed 5 May 1997.

CHAPTER 6

CONCLUSIONS

This study's objective was to answer the following primary research question, Is the current helicopter gunnery training strategy published and managed by the Army Aviation Center relevant for the AH-64D *Longbow*? Based upon the analysis conducted, the current helicopter gunnery training strategy is inadequate for the AH-64D *Longbow*.

The analysis reviewed the Army and USAAVNC support infrastructure, guidelines for and the quantity of training resources available, the capabilities and availability of TADSS for the AH-64D and AH-64A, and the doctrine and TTP available for *Longbow*-equipped units. Each of these have a major impact on the helicopter gunnery training strategy. The following paragraphs include a discussion of each of these areas.

Gunnery Infrastructure

The current gunnery infrastructure is not ready to support the unique training requirements of the *Longbow*. USAAVNC does not have an appropriate base to assist commanders, analyze results, and incorporate lessons learned into the gunnery strategy. The lack of commitment to the Aviation Master Gunner program, coupled with the lack of robust gunnery instruction during institutional training, has contributed to the general lack of knowledge among attack aviators in the basics of gunnery. However, the current gunnery manuals produced by USAAVNC are adequate for commanders to use in designing and executing a unit helicopter gunnery training program.

While they lack *Longbow*-specific information, the base concepts presented in FM 1-140 and ST 1-140-1 apply to *Longbow* units.

Resourcing

Based on assessments by aviation unit commanders on Unit Status Reports (USRs), there are enough resources to conduct helicopter gunnery training as presented in FM 1-140. While time as a resource is referred to in several studies, commanders are responsible for prioritizing unit training and cannot look to TRADOC and USAAVNC to provide more unit training time. While USAAVNC can affect the number of training requirements placed on the aviation unit through the Aircrew Training Program (ATP), there are no indications that there should be a change to the ATP in the near future.

Aircraft Specific Issues

AH-64D and AH-64A units will likely conduct basic and intermediate table helicopter gunnery training in a very similar manner. Advanced table gunnery will likely be very different based on the advanced target acquisition and communications capabilities of the *Longbow*. Even though the technology present in the *Longbow* appears to have the effect of minimizing crew inputs for target engagement, the *Longbow* crew's skills will be multiplied over the *Apache*'s crew. Reasons for this include the integration into the *Longbow* of a radar target acquisition system, an additional ATGM weapon system, and digital communications in addition to the capabilities of the *Apache*. Because of these advanced capabilities, it appears that the TADSS available to the *Longbow* unit commander will be less sophisticated, of lower fidelity, and of lower training value than those available to the AH-64A *Apache* unit commander.

Longbow Doctrine and TTP

USAAVNC has done an adequate job in producing initial *Longbow* specific doctrine and TTP. Presented in supplements to current doctrinal manuals, the doctrine and TTP are well-written, and serve as a base for integration of *Longbow* capabilities. Because the *Longbow* is a new weapon system, it is understandable that all of the capabilities have not been discovered; however, no employment doctrine exists for the myriad OOTW missions likely to account for the bulk of Army deployments in the next five to fifteen years.

Summary

Because of the advanced technology present in the *Longbow*, it is likely that maneuver brigade and division commanders will expect far more effects (i.e. increased lethality, more precise target acquisition, etc.) from *Longbow* units on the battlefield than current A-model *Apache* units. TRADOC is clearly focused on the technological side of the *Longbow*; the technical training of aviators, and the production of TTP for employment on a future, albeit generic, battlefield. While TRADOC builds non-unit specific training plans, writes doctrine, and oversees the fielding of TADSS, *Longbow* unit commanders will be responsible for training his unit as *Apache* unit commanders are now.

Maneuver Training Overview. The true essence of attack helicopters is the ability to move quickly about the battlefield, providing the force commander a very maneuverable and lethal force for battle. To completely exploit this capability, the *Longbow* unit commander will have to incorporate training that causes uncertainty among the helicopter crew members and causes friction in the unit. This training will develop the initiative among the crewmembers and the unit. Only when the *Longbow* commander can free the initiative in his subordinates will the unit be successful against a motivated, thinking enemy force.

Prussian military philosopher Carl von Clausewitz used the concepts of fog and friction to explain the reality of war. Friction, he said, "was the countless minor incidents...[which] combine to lower the general level of performance,"[1] while fog is the uncertainty which wraps itself around every activity in war. These concepts of fog and friction impact greatly on battle command, and combine to make a scientific notion of battle impractical. They are also useful in describing the challenges that will face commanders in the envisioned information-age warfare of Force XXI.

Clausewitz stated in *On War* that friction "is the force that makes the apparently easy so difficult" and that the accumulation of difficulties produces a friction that can be almost inconceivable for those that have not served in combat.[2] His examples of friction from *On War* tend to focus on the physics of the battlefield: the number of moving parts contained in the effort of moving and supporting an army. Friction, chance, and uncertainty still characterize battle. Their cumulative effect comprises the fog of war.[3] Clausewitz stated that "the fog of war" is derived from the general unreliability of all information. However, unreliable may be an improper term; overwhelming or irrelevant may be more appropriate descriptors. Thus, the interrelationship between information, intelligence, and knowledge will impact in the form of fog.[4] The lack of situational awareness and knowledge during the battles, coupled with friction throughout units will likely lead to decreased unit effectiveness and possibly defeat

Like the chess analogy used in chapter 5, the human dimension will become increasingly important with the introduction of new technologies, not less Fog and friction add infinitely more permutations to the moves available to forces in combat than those present in chess. Fog and friction will best be overcome by thinking, well-trained commanders capable of seeing the battlefield and exercising initiative during the fight. Because of this, unit commanders, not USAAVNC will ultimately be responsible for training *Longbow* crews to use initiative and overcome fog and friction.

Fog and friction are present in current operations. This is clear by the comments in chapter 4 of the Master Gunner discussing *Apache* battalion performance at the National Training Center (NTC). Because of the lack of uncertainty and chaos in home-station gunnery and maneuver training, *Apache* units are almost immediately overwhelmed when attacking a competent opposing force (OPFOR) at the National Training Center. While it is true that basic gunnery skills have been assessed as being weak, this could actually be a manifestation of the uncertainty experienced at NTC; the fog and friction of a new environment and a real OPFOR is likely so confusing and overwhelming for poorly trained individuals and units that basic skills become difficult to apply.

The goal of gunnery training as stated in FM 1-140 is the advanced tables which add maneuver to the skills evaluated in the intermediate tables. These tables should not focus on scores and statistics; rather, they should train and evaluate the ability for the platoon leader and company commander (as well as individual crews) to apply a thought process to accomplish a mission in a risky, uncertain environment. Unit commanders must take the lead to insure this training occurs. Even if USAAVNC had one hundred personnel assigned to a Helicopter Gunnery Department at Fort Rucker, this requirement would still be present and could only be overcome by unit-level training.

Simulators. This study addressed the simulation challenges found in the *Longbow* program. Discussions with the PM indicate that even though there will be both individual and unit simulation devices available for the *Longbow* unit, the numbers of devices will likely decrease as fielding approaches. Budget decisions will continue to impact simulation, both in quantities procured and the fidelity present.

Simulation strategy, however, has evolved much like aviation training and doctrinal literature and the design and capabilities of attack helicopters. There are many unanswered

questions concerning simulation. For example, an interesting phenomenon that is present in simulation training is the difference in the mental state of crewmembers during training in a simulator and performing the same tasks in the actual aircraft. Based on inconclusive research, there appears to be a relationship between the fear of injury or death and fog and friction. Conversations with aviators and personal experience indicate that because there is no fear of injury or death in a virtual simulator, crewmembers and leaders tend to approach training differently, either consciously or subconsciously, than they would if conducting the training while flying an actual aircraft. While no authoritative studies on the subject have been completed, it is reasonable to expect that a crew's bold action in a virtual simulator may not translate to bold action in an actual aircraft in combat. In other words, it may be impossible to trick the crewmember into a state of fear in the simulator. It also appears difficult to measure the level of confusion present in crewmembers before, during, and after training when risk is involved. Even though observers may see some signs of confusion or excitement in crewmembers in the simulator, the translation of performance between the simulator and aircraft is likely impacted by many additional variables. These variables in the real world may include aircraft maintenance problems, poor communications between aircraft, marginal weather, and night vision device usage; in short, risk. Because of risk, it is important that simulators are companions to live training, not replacements.

As French military philosopher Ardant du Picq stated in his book *Battle Studies*, military philosophers neglect the factor of man confronted by danger when studying the art of war. This is similar to the neglect shown by those who would replace larger portions of traditional live training with simulations to save money.

Training Statistics. The reliance on statistics to gauge the effectiveness of gunnery training may be counterproductive because the true results of training are difficult to reflect on the Unit Status Report (USR). Units continue to report themselves prepared for combat, while

simultaneously receiving cuts in personnel and training resources such as flying hours. Based on the analysis in this study, there appears to be little relationship between actual unit training levels, training resources, and true readiness for war. This can best be illustrated by unit performance at the Combined Training Centers (CTCs). With our current training strategies, what would happen if an *Apache* battalion was deployed and committed into combat against a highly trained, motivated enemy without a *Desert Storm*-like six month train-up period? Would the unit's individual and collective performance be similar to that witnessed consistently at the National Training Center?

There are unofficial reports that one reason tank gunnery scores in US Army Europe have risen to near-perfect levels is that some units know where all of the targets on the range are located, and prepare their crews to acquire and engage those specific targets. A tour of the Grafenwohr Training Area (GTA) range in 1993 revealed that tank gunnery targets had beaten zones in front of them. These beaten zones were patches of ground that had been defoliated by repeated impacts of tank-fired munitions. Based on these zones, the tank crew was able to easily identify the areas where pop-up targets were located. In 1994, a tour of the Infantry's Master Gunner Unit Conduct of Fire Trainer (U-COFT) facilities at Fort Benning, Georgia showed this same phenomenon. Instructors at the course stated that students are able to memorize the patterns of targets generated by the computer in the U-COFT and achieve artificially high scores. Because of this, the scores posted in U-COFT exercises may be equally suspect.

If these statements are true, some unit gunnery training may be counter-productive because there is almost no uncertainty generated during the training. This training would have degenerated to the point where the crews are merely lab rats that are trained to run through a maze, not make decisions. Rote behavior is clearly not the intent presented in the Army's gunnery manuals; however, the preoccupation with scores on the range may drive commanders to treat gunnery as merely another time-intensive training event that must be completed. Therefore, the focus of the

training is successfully completing the required number of engagements, not producing a thinking crew and unit. While the statistics reported are likely the highest ever, this leads to an obvious question: will a tank unit have the ability to acquire and engage targets in combat because they successfully complete Table XII at GTA?

Conclusion. Unit commanders obviously think that their units' are trained to standard; however, they may not completely understand that standard. Based on conversations in March, 1997 with staff officers serving on the Army Staff, there are no indications that aviation or other combat arms units are not ready for combat; that is, no indication exists on unit status reports. This leads to at least three possible conclusions: first, all Army units are ready for combat in spite of the widely reported shortages in personnel and resources; second, commanders may not know how to accurately assess readiness for combat; or third, the unit status report does not adequately gauge training as a subset of overall readiness.

Perhaps the evaluation of unit readiness and training effectiveness for aviation units has evolved much like the aircraft and employment doctrine as mentioned in chapter 2. Commander's must have a feel for whether their unit is ready for combat. Based on the criteria in AR 220-1, this feel translates into the unit training level and overall readiness condition reported to the Department of the Army. Because of the subjective nature of these assessments, there are likely disparities in readiness between similar units that will never be manifested on the unit status report. In light of this, and if Army force-projection doctrine is to be followed, traditional methods for training and assessment may lead to disaster in future combat. The relative ease with which the Iraqi Army was defeated in *Operation Desert Storm* has likely led many to develop a false sense of security in the methods used to train Army aviation units. The NTC experience is not out of the ordinary; it is an example of how units would perform in combat when deployed on short notice to fight a

competent, determined enemy. Because of these facts, the Army's helicopter gunnery training strategy is unacceptable for the *Longbow*.

In the course of this study, several pre-conceptions were proven untrue. The following are additional findings bearing on the problem:

1. Scored advanced table gunnery is counterproductive. These tables should be free of statistics and allow the commander to train his subordinates in a risky, chaotic environment. The application of scoring statistics would likely dilute the effectiveness of the training.

2. There should be more ammunition allocated to intermediate tables. The major reason for this is to ensure crews are proficient in basic marksmanship and to keep training levels high during periods of crew turnover.

3. Attack helicopters have done well in combat if the units are given the opportunity to train and gain experience with fog and friction on the battlefield.

4. USAAVNC cannot train crews; their charter is individual training (attack helicopter crews are two aviators working together). Units are responsible for building crew competency. This may be resolved with more emphasis on fog and friction in all training events, building initiative in crews and leaders.

Secondary Research Questions

Question 1: Does the present USAAVNC helicopter gunnery training strategy support current Army doctrine and training requirements?

Finding: According to reports from Aviation unit commanders, the current strategy is adequate for the aircraft presently fielded. However, reports from NTC indicate that there are deficiencies in gunnery skills across the Aviation force. These deficiencies may result from both

poor unit and institutional training, but there is no definitive data to positively identify the causes for this trend.

Question 2: Is TRADOC properly preparing for *Longbow* employment and training for the near term (5-10 years)?

Finding: Based on regulations, available materials, and the precedents set during AH-64A fielding, TRADOC is following the proper procedural model for training of *Longbow* aviators in the school environment. However, it appears that there was not a great deal of analysis conducted into the specifics of *Longbow* employment when the aviator qualification course (AQC) was built for USAAVNC; therefore, it will be very much like the current *Apache* AQC while not particularly focused on the unique capabilities of the *Longbow*. In addition, there will likely be shortfalls in simulation and live-fire gunnery capability for *Longbow* units, particularly in virtual simulation and objectively-scored *Hellfire* training missile engagements.

Question 3: If required, how should Army Aviation modify its current gunnery training strategy for the *Longbow*?

Finding: Based on analysis of available materials, TRADOC should build a gunnery infrastructure for Aviation similar to that of Armor branch. There are so many facets to *Longbow* gunnery training (capabilities of the aircraft, what does the Army want to train, resourcing, etc.), that there should be a staff robust enough to adequately study the subject and make recommendations. It is clear that the bulk of the *Longbow* training model is an evolution of the *Apache* training model currently being used. This is much like how *Cobra* doctrine and training models were used during *Apache* fielding.

Recommendations

1. USAAVNC should devote more resources to a helicopter gunnery-specific department at Fort Rucker. With the current fielding of the *Longbow*, and the *Comanche* in the not-to-distant future, a structure must exist to ensure that attack helicopter gunnery TTP and lessons-learned are incorporated into manuals and training materials. The structure used by the Armor Center for its Crew Gunnery Branch would be a good starting point for an Aviation Gunnery Branch. This initiative should also include recruiting top Aviation officers for service at USAAVNC.

2. USAAVNC should reexamine the TADSS strategy for *Longbow* units; specifically, the viability of using the LCT as the primary training device. Issues include the practice of applying time logged in the simulator to flight minimums, night system currency, and the ability to conduct checkrides. Based on the facts available, it appears that Aviation Branch is regressing in the quality and quantity of simulators just as helicopter technology is progressing.

3. USAAVNC should introduce a master gunner block of instruction into the *Apache*, *Longbow*, and *Kiowa Warrior* instructor pilot's course. This block would focus on qualities and responsibilities of the Master Gunner as stated in FM 1-140 and ST 1-140-1 during an existing program of instruction (POI). This program would likely encourage an emphasis on gunnery at unit level. In addition, USAAVNC should commit to publishing ST 1-140-1.

4. The Army should continue to pursue objective scoring methods for the *Hellfire* training missile. This includes fielding a suitable boresight target for the *Apache* and *Longbow* Target Acquisition and Designation System (TADS).

5. USAAVNC should continue to refine the advanced table gunnery materials found in FM 1-140. This refinement should include enhanced training scenarios that allow introduction of uncertainty and "fog" into the conduct of the scenario. This initiative oriented training should also be incorporated into TC 1-210.

Further Study

The Army continues to invest heavily in attack helicopters. Further study is needed in the following areas to help refine the requirements for further attack helicopter training and doctrine development:

1. The link between unit readiness as reported on the USR and readiness for combat.

2. The simulator fidelity required to adequately train helicopter pilots on base and mission tasks.

3. Is the attack helicopter unit's operational tempo (OPTEMPO) too high to allow the conduct required training? Do requirements imposed by higher headquarters prevent thorough training of all tasks? If so, is it being reported?

4. The link between showing proficiency on a task in a simulator and showing proficiency on the same task in an actual aircraft.

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[1] Carl von Clausewitz, "Friction in War," *On War* (Princeton, NJ: Princeton University Press, 1976), 119-121; excerpt reprinted in US Army Command and General Staff College, *C610 Term I Syllabus Book of Readings* (Fort Leavenworth: USACGSC, July 1992), 228.

[2] Ibid., 229

[3] Joint Chiefs of Staff, Joint Publication 1, *Joint Warfare of the Armed Forces of the US* (Washington: US Government Printing Office, 10 January 1995), I-2.

[4] Information is raw data. Intelligence is information with analysis applied. Knowledge is intelligence fused with situational awareness that can lead to decisions by commanders. US Army, FM 100-6, *Information Operations*, (Washington: Department of the Army, 27 August 1996), 2-1

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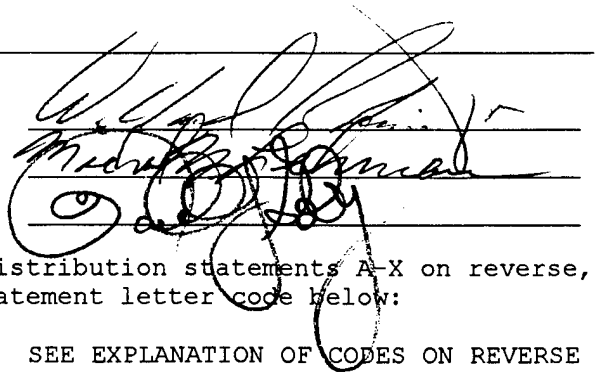

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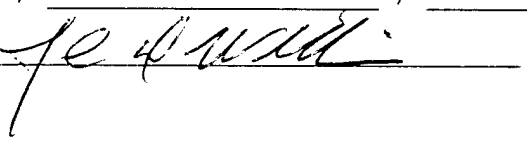
7. MMAS Thesis Author's Signature: 

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